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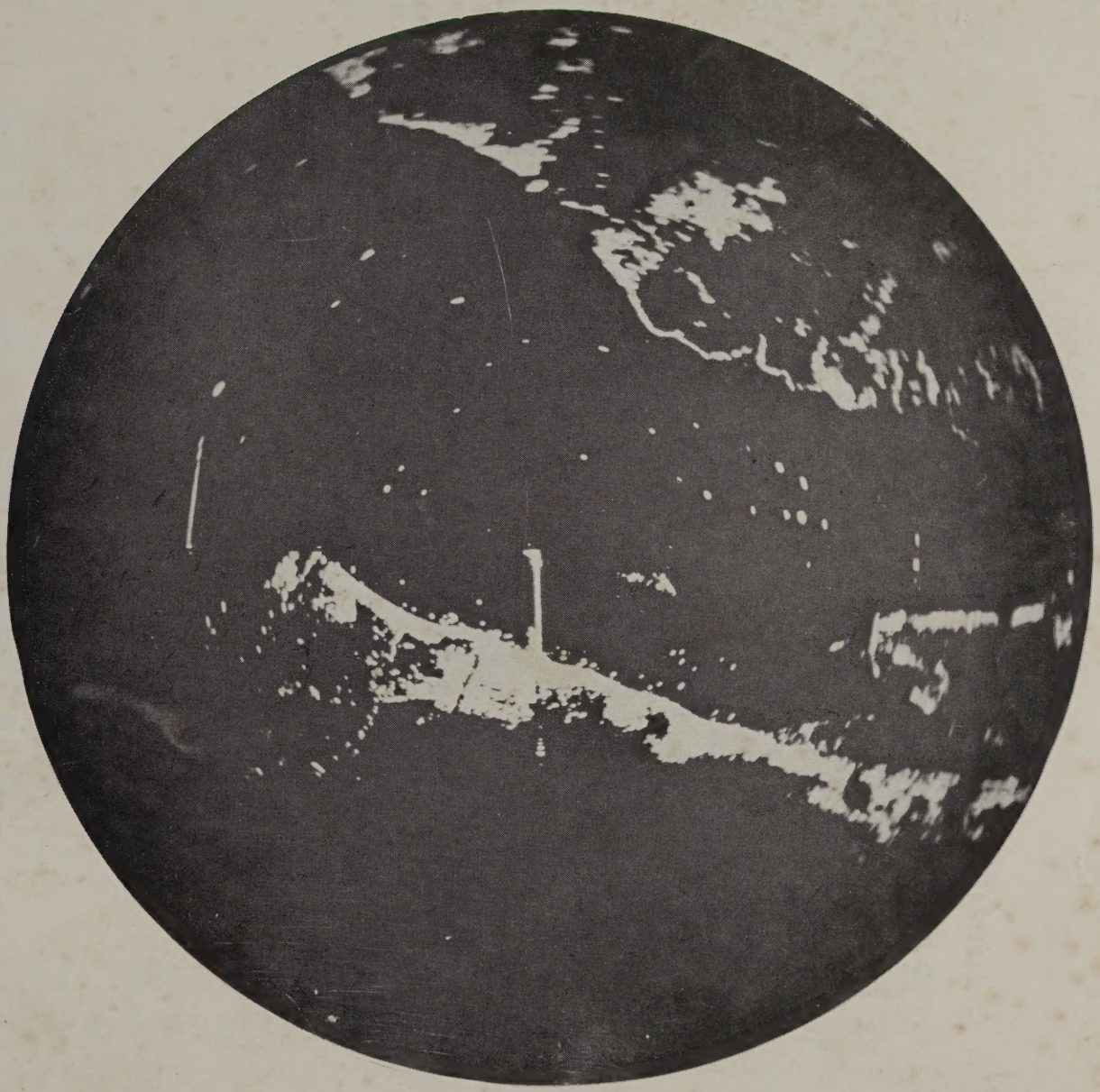

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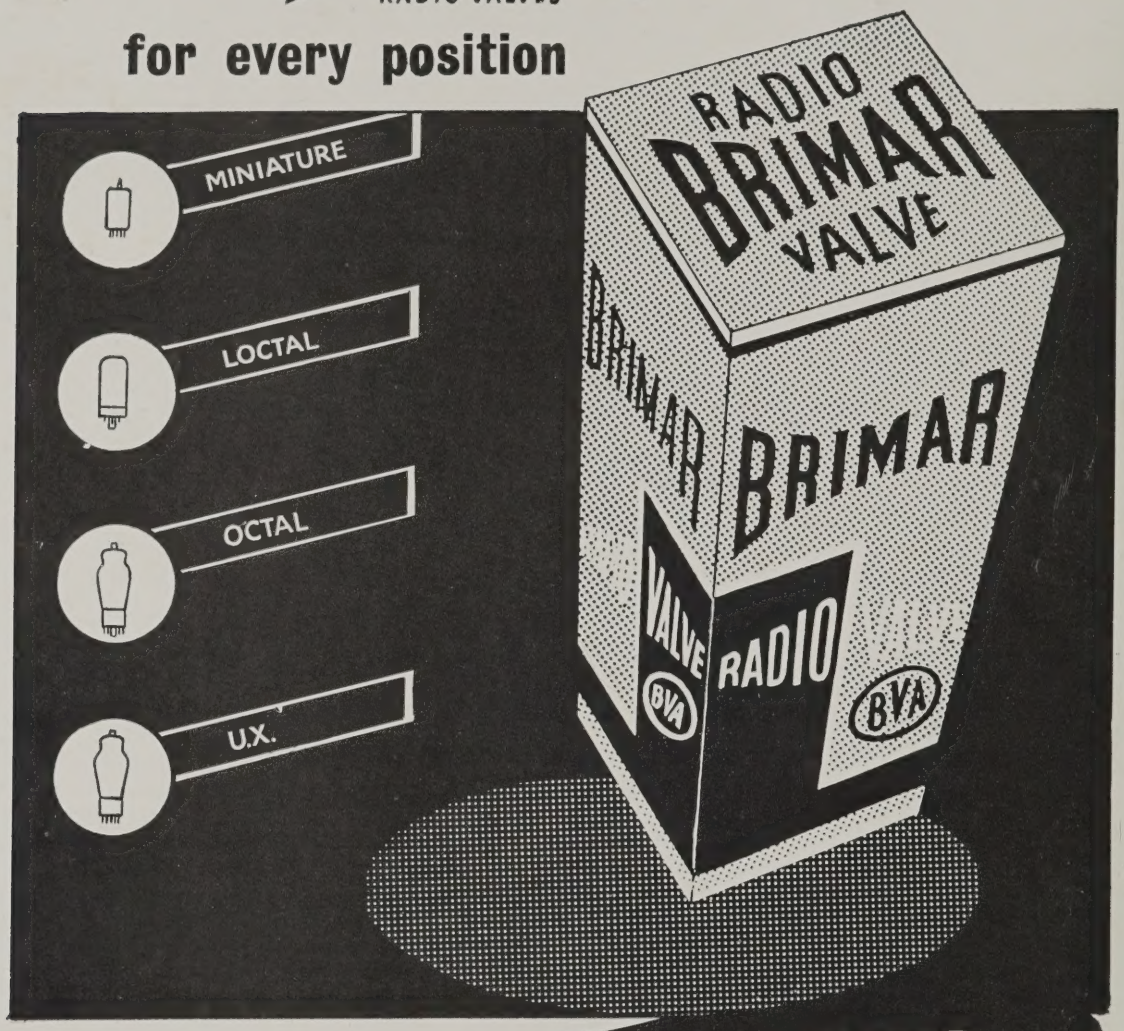

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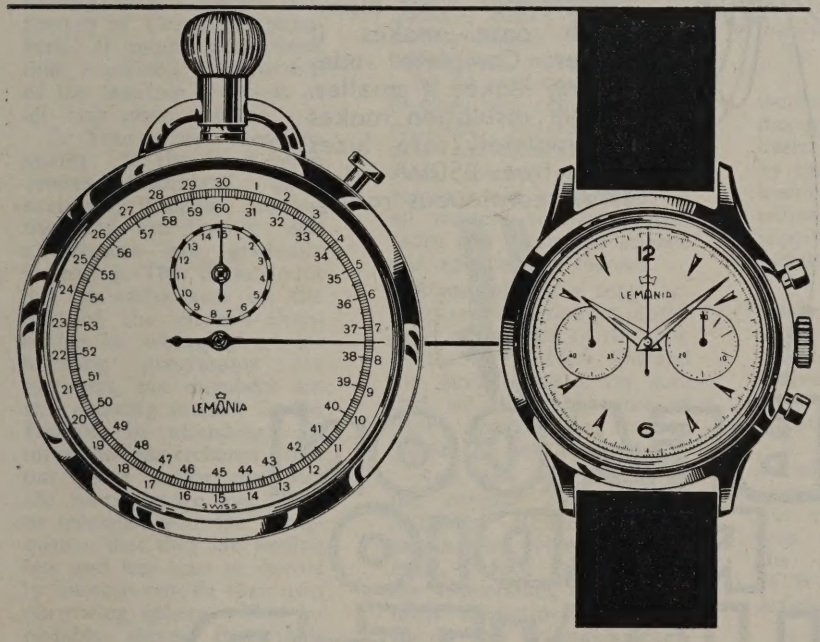

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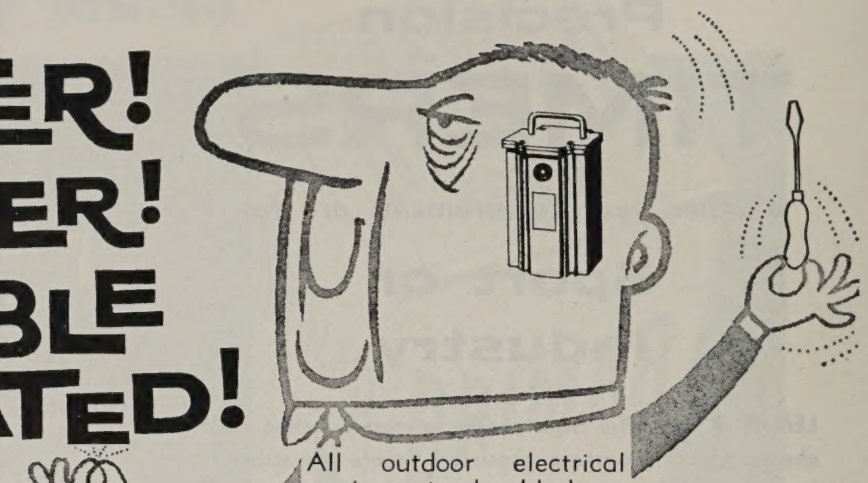

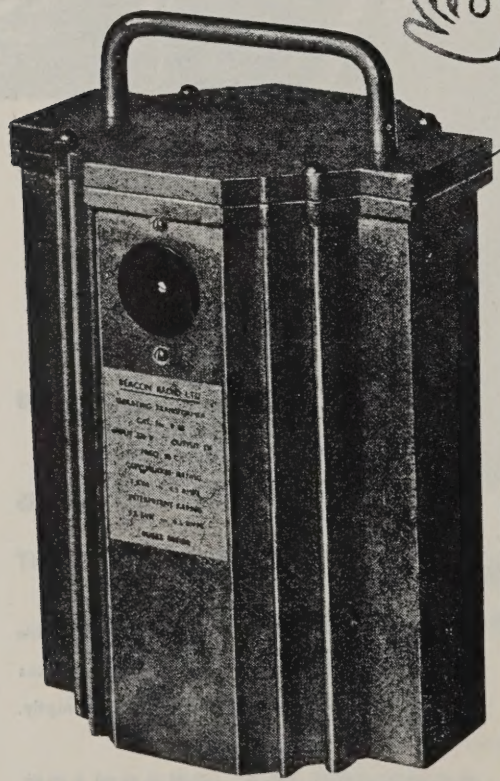

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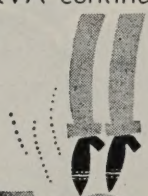

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Letters from Readers

N.Z. ELECTRONICS INSTITUTE

Sir,

I read with interest and consternation the article in your February issue by C.W.S. entitled, "Co-ordinated Research — Another Viewpoint." With interest, because he has raised a number of thought provoking matters and with consternation, because of the erroneous view he has of the New Zealand Electronics Institute. Taking the Irish view and looking at the second matter first I would like to make known the following facts concerning the New Zealand Electronics Institute.

1. **Membership** Total membership now stands at some 200. It is admitted that this represents a lower proportion of electronics personnel than we would wish but membership is increasing steadily and what is perhaps more important, membership standards are rising. This means that in a few years time we can expect about double this membership with a higher proportion of Corporate Members. (I might add there that Auckland membership of the Institute is lowest of all four main centres).

2. Your writer mentions apathy. In the three main centres (Auckland again excluded) Branches are active and are finding that attendances are gradually increasing. This is no doubt due to enthusiasm on the part of the Branch Committee in arranging an interesting programme for members, but members are still showing interest in the Institute by attending. It must be remembered that our more senior members are forced more and more to specialise with the consequence that they are finding less and less time to devote to interests outside their own narrowing sphere. This inevitably means that their presence at General Meetings is more of an occasion than a habit, but to balance their absence we are finding many of the junior members are regular attenders. Surely, this is as it should be? After all, the senior members are not lost to the Institute—they will always take an active interest in their own particular field.

3. The New Zealand Electronics Institute has always been prepared—and would welcome the opportunty—to publish any worthy paper presented to it. This is one aspect of the Institute's activities that has never arisen.

I feel that it would be appropriate at this stage to quote the objects of the New Zealand Electronics Institute.

(a) To promote electronic science and all its applications and to encourage the spreading of electronic knowledge among the members.

(b) To promote understanding of the different specialised branches of electronics and to bring into mutual association all those engaged therein.

(c) To initiate and encourage research and invention in electronics and to provide for the discussion of the results of such research and for their publication.

(d) To promote information in the science of electronics by discussion, examinations, books, papers and correspondence with other bodies and individuals.

(e) To hold meetings, conventions and exhibitions for readings, lectures, discussions and demonstrations of ideas, theory, practice, inventions and applications in all matters connected with radio and electronic science and applications thereof.

Some of these may appear to be somewhat ambitious in the light of the state of the art in New Zealand but nevertheless I am sure that we shall see some of them brought to fruition within the next five years.

And now to deal with the original subject "Co-ordinated Research." Research in New Zealand must, I feel, fall back on the Universities or Government Departments. Industry in this country, generally is not on a large enough scale to support research on anything even remotely approaching the scale of overseas Companies such as Philips, R.C.A., G.E.C. to name but a few. On the other hand, development work (which could almost be called research but in some specific direction) is undertaken on a large scale. However, this development work is almost exclusively the province of Industry, and consequently the findings are likely to be jealously guarded—and understandably so—for they represent a considerable investment. Doubtless there is the possibility of publishing some of the findings but generally speaking, a firm is not likely to disclose its hard won secrets to all and sundry.

I would be the first to agree that these circumstances show room for improvement as I have personally seen the situation where we have several workers in the same field struggling for the same solutions to the same problems —and yet unable to co-ordinate their efforts because of their industrial positions. Yet if they were all to work together in one laboratory would we not see only one set of ideas emerge rather than several? Who is to say which is the correct solution to a problem? The very essence of our political outlook depends on individual thought; in the scientific and technical sphere it may very well be uneconomic but it is certainly productive of original work.

To sum up:

1. A Radio and Electronics Research Association dealing, as it must do, with basic research as envisaged by the Earl Mountbatten, as mentioned in your January editorial, is unable to be supported in this country by Industry at present.

2. The co-ordination of research at anything other than basic level is an impractical proposition in the individualistic business society that exists in this country.

3. However, account must be taken of the fact that the climate in this country does not encourage the publication of original work for the reasons outlined by "C.W.S." in your February article.

4. There is now in this country the nucleus of a vigorous Institute keen to encourage and publicise any original work that is undertaken and submitted to it.

L. C. PARRY,
President,
The New Zealand Electronics Institute Inc.

The above letter was received some time ago and in the meantime some correspondence with the Institute has ensued. A later letter indicates that the Institute may possibly amend its membership requirements and, no doubt, when this comes about it will be of interest to all readers. In the meantime, I still hold to the opinion that two professional electronics bodies in New Zealand would be unwise and weaken cohesion at that level.

Elsewhere in this issue is a list of the local branches of the Institute, so that those interested may obtain further information.

Arrangements have been made to publish regular notes concerning the Institute's activities and the first of these will appear in our next issue.

C.W.S.

* * *

INTENDING MIGRANTS FROM THE U.S.A.

Sir,

One of the members of our organisation who is now residing in Wellington, New Zealand, has sent me several copies of your excellent magazine. I read all similar American publications, and am pleased to state that I find yours to be equal to any, and better than most.

My purpose in writing is to ask your help, and the help of your readers. I represent a group of American citizens (within the membership of the American Emigrant's League) who desire to emigrate from the U.S. to New Zealand, and enter the manufacture of hi-fi audio equipment and similar products.

We are very much interested in what products are currently being manufactured and in the availability of N.Z. made components. Any and all information which you can send us, or other sources of information you might suggest will be appreciated.

We would also be interested in corresponding with radio and television repairmen in N.Z.

JOHN W. MASSECAR,
P.O. Box 44,718,
Los Angeles 44, Cal.,
U.S.A.

We are replying separately to your letter but publish it here so that any readers interested may write to the address shown above.
—Ed.

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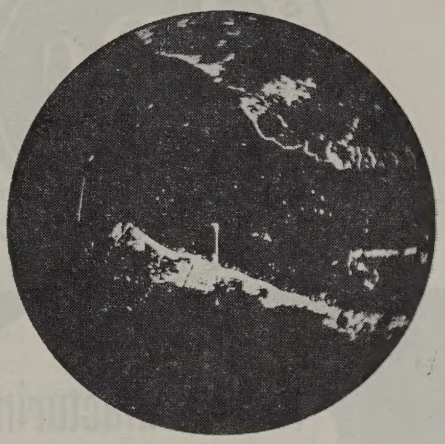

Contract For Latest Navigational Aids For New Port At Whangarei Awarded to A.W.A.

The new facilities being constructed on the Whangarei Harbour at Marsden Point are to serve New Zealand's new ten million pound oil refinery, which is due to come on stream early in 1964. The majority of the shipping will be tankers, of which a large proportion will be supertankers discharging bulk crude oil.

The trade of the port will increase from 383,000 tons for year ended 30th September 1962, to over 5 million tons in 1965 and over 6 million tons in 1967. In 1965 the trade of the port will represent 30% of the total New Zealand cargo tonnage.

Included in the project are a new 1,500 ton slipway, two 1,600 h.p. diesel electric tugs and a pilot launch.

(continued on page 6)

Featured Next Month

- ☆ A 6 Metre Converter
- ☆ Looking At Microphones
- ☆ Constructing A Stroboscope
- ☆ Electronic Switching

OVERSEAS NOTEBOOK : NEW PRODUCTS : SHORTWAVE SURVEY : TECHNICAL JOURNALS CONTENTS

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NAVIGATIONAL AIDS AT WHANGAREI

continued from page 5

Having in mind the importance of efficient communications in a harbour scheme of this magnitude, the Whangarei Harbour Board drew up a rigid specification of operational requirements. The successful tenderer was Amalgamated Wireless (Australasia) N.Z. Limited, for a completely engineered and installed system involving Medium and Very High Frequency communication equipment, Radar, Hydrographic survey apparatus and Recording Tide Gauges. The order is valued at £20,000.

A.W.A. has undertaken to establish Radar and Communication service facilities at Whangarei, and Mr. W. Haines, presently with the A.W.A./Marconi Radar Engineering group on the Momona Surveillance Radar installation, has been selected for transfer to Whangarei when the installation programme commences in July 1963.

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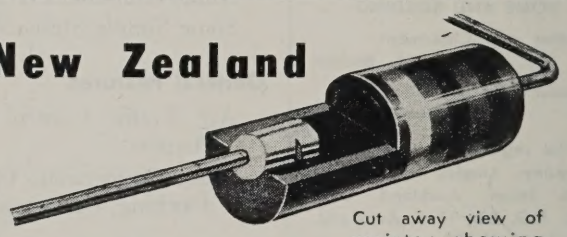

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Research ... the theme for 1963

Over the past few months, there has been steadily increased pressure on the Government from many parts of the scientific and industrial community, to increase the amount of Government money which will be spent on scientific and industrial research.

In terms of our annual expenditure, Government spending on pure research, and scientfic development, is a very small percentage of the annual expenditure. However, the Government should not be expected to bear the brunt of all the nation's research efforts, but it can well afford to give leadership and stimulus to the country as a whole. Realising this thought, several prominent sections of the community have been outspoken in an attempt to get business, professional, and scientific circles alike, to devote a great deal more of their time, interest and money, to the very important problem of stimulating research in their own particular facet of the community.

A suggestion recently, that 1963 should be a year devoted to research, has won solid support from both business and professional leaders. This suggestion was put forward by the President of the Medical Research Foundation in Auckland. In support of this proposal, Sir Douglas Robb, Chancellor of the University of Auckland, made some comments on the subject, two of which we are pleased to quote.

"If ever there were an age, in which we needed to slough off complacency and the cosy and comfortable balances of power we have achieved in the past, it is now. Patterns of trade and communication, of production and distribution, are in the melting pot. Never has there been a time when the enterprising ones have had such a chance."

"To put up this idea of a research year or an anti-complacency year is to mobilise mental and spiritual forces in the more tangible fields of business and science."

This country has and will have, for some time to come, problems with overseas balance of payments. We are faced with the challenge or producing more of the technical and scientific products in addition to consumer goods, which are needed. This means that we must have the trained technical staff to organise and control these new ventures. It seems however, that one of this country's main exports is trained technical staff. It has been stated many times that there is little reason for them to stay here because of the low salaries paid to these men, and the lack of opportunity.

It is not the place of this journal to tell any business manager what he can, or can not, afford to pay his highly trained technical staff. What we do attempt, is to show what is happening overseas, to give a lead to both the technical and business section of the electronics industry, in particular, to what can be done, in this country if we want to try. Whilst not alleviating the financial problems of the technical men, more interest and money devoted to research and development by the industry, will certainly make it more attractive for our technical staff to remain in this country.

There can be no complacency where research is concerned. We must take the problem completely and successfully. As a stimulus to these thoughts, the Royal Society in this country has also given a lead in an endeavour to stimulate research and development in 1963. With the backing of such people as the Medical Research Foundation and the Royal Society, the Government must show the way in the next few years. Woe betide the electronics industry if it is not in the forefront of such a move. The benefits of research must not be pidgeon-holed or side tracked; they must be used and implemented as soon as practical, if this country is going to remain, even on a par with other parts of the world.

I.H.S.

TECHNICAL JOURNALS — *Contents List*

"Q.S.T." — U.S.A. — September 1962

"A Crystal-Controlled 1296 Mc. Converter", by H. M. Meyer, JR., W6GGU.
"Q.S.Y. de Front Seat", by Robert Olsen, W4AVW.
"Transmitting with Transistors", by Rene Goldbeger, VE3ABU.
"Another Phasing-Type S.S.B. Exciter", by R. L. Evans, K9YHT.
"DX-100 Modifications", by G. L. Countryman, W4JA.
"6GJ5's On 6 Metres", by L. G. McCoy, W1ICP.
"Oscar I. A Summary of the World's First Radio Amateur Satellite", by W. I. Orr, W6SAI.
"A Magnetic-Tape Second Operator", by W. L. Smith, W3G KP.
"A Transmitter Metering Unit", by R. M. Brown, VE3BWL.

Electrical Review — U.K. — 7th September 1962

"Dimming Techniques for Fluorescent Lamps", C. R. Passmore (Atlas Lighting Ltd.).
"Cells, Batteries and Chargers", A Survey of Considerable Interest.

"Radiotronics" — Australia — September 1962

"Temperature Ratings and Thermal Considerations"
"Computer-Transistor and Tunnel Diode Application Circuits".
"Transistor Power Supply No. 2" by B. J. Simpson.

"Radio, Television and Hobbies" — Australia — September 1962.

"A Distortor, Noise, and Millivoltmeter", Part 1, by Jamieson Rowe.
"A More Effective Method of Synchronising the Miller Integrator Timebase", by Jamieson Rowe.
"A Symplified Light Beam Relay", by Ian Pogson.
"The Tremodyne Four", by Keith Jeffcoat.

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"Electronic Etching of Videotype", by N. F. Bounsall of Ampex Corporation, U.S.A.
"Ban the Reciprocity Theorem", by T. Roddam.
"New Phase-Splitter", by A. R. Bailey, M.Sc. (Eng.)., A.M.I.E.E.
"Modulation Meter", by H. B. Bent, G2MC.
"The Classification and Retrieval of Technical Information, Part 2. The Notched Card System in Practice", by A. E. Cawkell.
"Turntable Rumble and Pickup Arm Design", by J. Walton of Decca Record Co.
"A Combination Lock". — An exercise in Relay Switching, by V. J. Phillips, Ph.D., A.C.G.I., D.I.C.
"New Tunnel Diode Circuits", by M. Lorant.
"Excitations and Responses" — Cont., by "Cathode Ray".

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"Hybrid Receiver for Mobile Operation", by J. A. H. Spratt, M.I.R.E., G3KWG.
"Indoor Aerials for Multi-band Working", by J. N. Roe, M.I.R.E., F.R.S.A., G2VV.
"Basic Electronic Key", by L. H. Thomas, M.B.E., G6QB.
"Output Stage Noise Limiter".

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"Equalization for Tape Recording and Reproduction", by P. J. Guy of the B.B.C. Engineering Dept.
"Transistor-Diode Static Switching Units", by J. F. Young, A.M.I.E.E., A.M.Brit.I.R.E.
"Internal Resistance of Feedback Amplifiers", by E. de Boer, P.H.D.
"The Recording of Conditioned Eylid Movements", by A. Hackwood; W. A. King-Frost and D. Walton.
"Pulst Transformers, Frequency Response, and Wide Band Transformers", by C. F. Wilds, Grad. I.E.E.
"An Electronic Stimulator for Physiological Use", by E. A. Annand of the New Zealand Medical Research Council.
"The Use of Direct Coupled Logic in the Design of an Arithmetic Unit", by P. L. Owen, B.A., T. R. H. Sizer, A.M.I.E.E. and M. F. Partridge, M.A.
"A Power Supply with a Stabilized Power Output", by W. A. P. Young, A.M.Brit.I.R.E.
"A Heart-Rate Meter for Clinical Use", by G. Sloman, M.B., B.Sc., M.R.A.C.P. and G. Tyson, Dip.Comm.Eng., of the Royal Melbourne Hospital, Australia.
"A Fast Pulse Generator, by K. A. Aitchison and B. Collenge, P.D., B.Sc.

"British Communications and Electronics" — U.K. — September 1962

"Instrumentation of a Rocket Engine Test Facility", by A. W. T. Mottram, B.S.c., A.M.I.Mech.E., A.F.R.Ac.S.
"Automatic Landing for Civil Aviaton — An Appraisal", by F. J. Sullings, A.M.I.E.E.
"Environmental Testing for Service Electronic Equipment", by S. C. Schuler, Assoc.I.E.E.
"An Automatic Picture Digitizer", by A. H. Duncan.
"An Airborne Data Recording System", by M. A. Perry, D.C.Ac., A.M.I.Mech. E., A.F.R.-Ac.S. and R. G. Thory, D.C.Ac., Grad.I.E.E., Grad. R.Ac.S.
"The Legal Protection of Inventions", by G. S. Monteith, B.Sc., A.M.I.E.E., A.Inst.P., M.B.I.M.

"Proceedings of the I.R.E." — U.S.A. September 1962

"Quantum Effects in Communications Systems", by J. P. Gordon.
"Negative Impedance Electrometer Amplifier —An Introduction", by E. F. MacNichol, Jr., M.I.R.E. Editor I.R.E. Transactions on Bismedical Electronics.
"Cathode Follower and Negative Capacitance as High Input Impedance Circuits", by C. Guld.
"Stabilized Wide-Band Potentiometric Preamplifiers", by J. W. Moore, Senior Member I.R.E. and J. H. Gebhart.
"Bandwidth Limits for Neutralized Input Capacity Amplifiers", by R. L. Schoenfeld, M.I.R.E.
"On the Reception of Partially Polarized Radio Waves", by H. C. Ko., Senior Member I.R.E.
"Coherent F.D.M./F.M. Telephone Communication", by J. A. Develet, Jr., M.I.R.E.
"A Piezoelectric-Piezomagnetic Gyrator", M. Onoe, M.I.R.E., and M. Sawabe.

Electronics — U.S. — 24th August 1962

"Simple Curve Tracer Displays Transistor Beta," by J. V. McMillin (Measurement Research Centre, Inc.).
"Transistor Circuits Control Small D.C. Motors," by F. W. Kear (Lytle Corp.).

Electronics — U.S. — 31st August 1962

"Long Staircase Generator," by K. Perry (Univ. of Queensland).

Electronics — U.S.A. — 7th September 1962

"Simplified Low Pass Filter Design", by W. J. Kerwin.

Electronics — U.S.A. — 14th September 1962

"Compact New Instrument Finds Undersea Cable Faults", by F. Jones (B.P.O.) and J. H. Reyner (Furzehill Labs. Ltd.).

"Journal of the British Institution of Radio Engineers" — August 1962

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Measurement and Control—U.K.—August 1962

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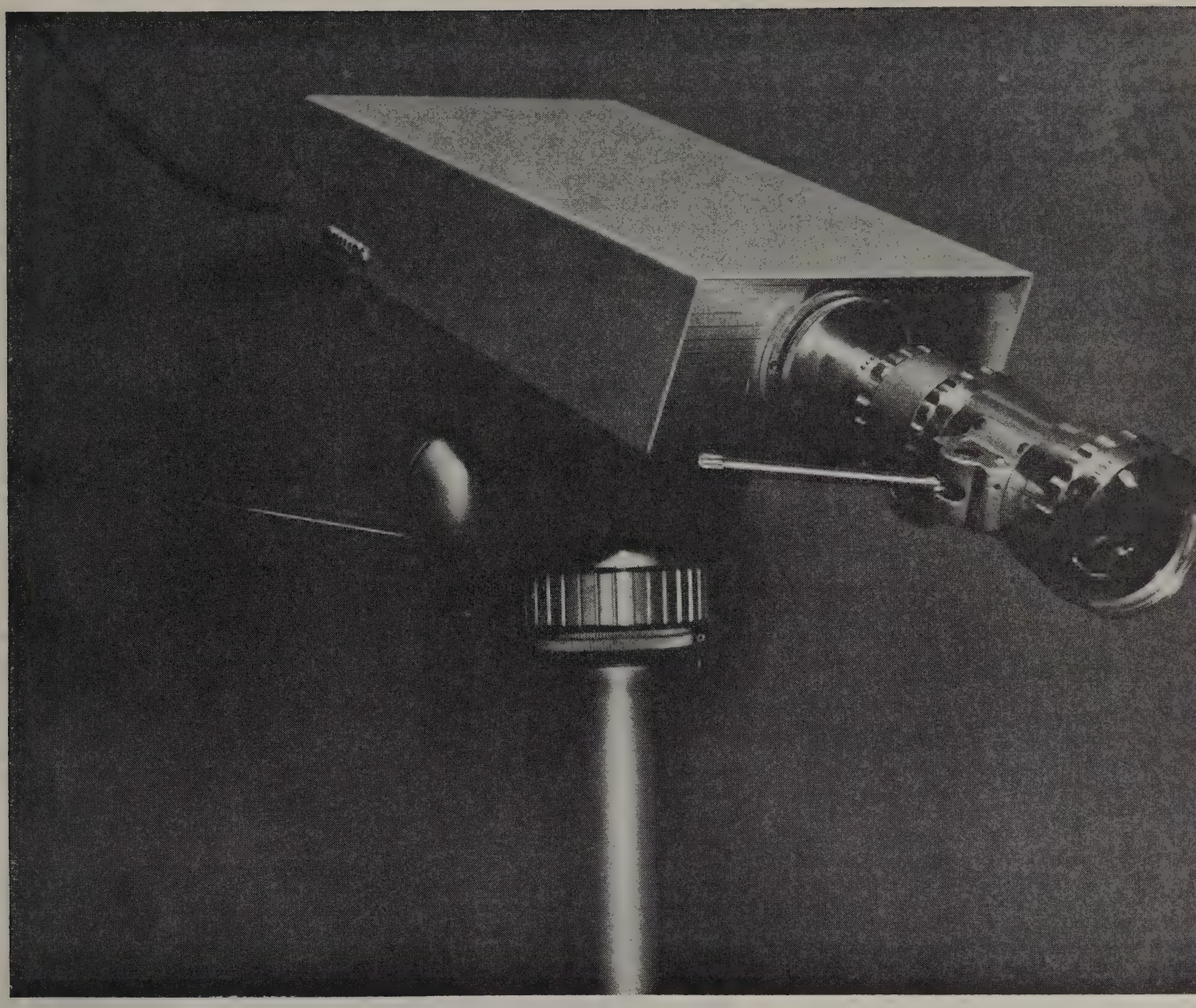

THE PHILIPS EL8000 COMPACT TELEVISION CAMERA

A transistorized camera, self-contained, and simple enough to be handled by the layman, forms the nucleus of a variety of closed-circuit television systems. A video output allows connections to a video monitor as an alternative to H.F. output for connection to a television receiver. Only the lens and diaphragm require manual adjustment. A complete set of accessories includes lenses, weather-proof housing, tripod, pan and tilt head, and remote controls.

This photograph shows the camera fitted with a zoom lens.

AIR TRAFFIC CONTROL IN A LARGE AIRPORT

The Southern Air Traffic Control Centre, located at the northern side of London Airport (Heathrow), is responsible for all aircraft movements over the southern half of the British Isles.

Despite the rapidly increasing speed and density of air traffic, methods of control have altered very little in the last 15 years, and to maintain sufficient control over each aircraft it has been necessary to divide the area into a number of smaller sectors. The use of surveillance radar has played a very large part in making it possible to handle the large volume of traffic.

The radar controller, whose function it is to assist the procedural controller directly responsible for the aircraft, normally monitors the progress of all aircraft in his sector, but at points of high traffic density he may take over complete radar control, through his procedural controller, of a group of aircraft. This makes it possible to permit aircraft to fly along airways with only five nautical miles separation. Without radar control, the procedural controller, who has only the pilot's reported position over beacons on which to plan flights, normally has to maintain ten minutes separation between aircraft. The request for radar control comes from the procedural controller over an intercommunication system. The details of the request have, in the past, been written on an edge-lit perspex board next to each controller, by an assistant listening continuously to the intercommunication system. The presence of the assistant, has created a distraction of the controllers' concentration. S.A.T.C.C. are now separating the radar controllers from their assistants to remove distractions. In one area of the control room the assistants will monitor the intercom lines continuously and write the relevant flight information on translucent perspex screens using chinagraph pencils. Marconi television cameras, installed behind each screen, will produce a high definition picture which can be seen by the controller on a television monitor placed next to his radar screen and in the same console.

In order to ensure that this handwritten information appears sufficiently clearly on the television screen to eliminate the possibility of error in reading, even with characters at the very edge of the screen, unusually high standards of definition are essential, considerably higher than normal broadcast transmission standards. Marconi selected for this task a vidicon camera designed for high quality telecine broadcasting work and a number of modifications were incorporated in it to meet the very high specification demanded by the Ministry of Aviation. The 8½ inch monitors also had to be modified from existing high quality designs and the standard of definition produced makes it possible for a controller to read hastily scrawled symbols, even at the edge of the screen. A push button unit associated with each monitor enables the controller to receive on his own television screen not only the flight information relating to his own sector but also to other sectors.

The controllers are now able to work under quieter conditions and, at the same time, the radar assistants are no longer obliged to work under restriction.

Fifteen edge-lit perspex traffic information boards are installed in a set of consoles arranged in a single composite group.

The whole operation of this new radar control system will be entirely dependent upon the television equipment. Three of the fifteen camera positions are installed on a 'stand-by' basis, and will be permanently kept in readiness in case one of the twelve channels in use should develop a fault.

The camera control units and power supplies associated with the 15 cameras are installed in a suite of racks in a separate room. Also contained in these are vision distribution amplifiers type BD 886 and resistive splitting networks, providing 25 separate vision outputs from each camera channel. Twenty-five vision switching units type V 4720, de-

(continued foot next column)

Audio Amplifier Damping Factors

The damping effect of an amplifier on the associated loudspeaker is often a point for controversial discussion. This short article attempts to explain what this effect is, and how it is measured.

When an amplifier is feeding into a speaker of relatively high efficiency, it is usually felt that the higher the amplifier's damping factor the better would be the result as it is effective in damping out undesirable speaker resonances.

With the advent of the high quality, but lower efficiency speakers, especially when they are mounted in infinite baffles or other such enclosures, that do not add to the bass response, the use of an amplifier with too high a damping factor is undesirable. This could result in excessive damping of the speaker, thereby reducing its output, particularly at low frequency end of its range.

Amplifier Damping Factors

Typical values of the damping factor of some certain types of amplifiers are outlined here. In general the main determining factor is the type of output circuit used.

With push-pull triodes without feedback, the damping factors are probably in the range of 2 to 4. With push-pull beam power tubes, the damping factor is apt to be less than this, unless negative feedback is used. With large amounts of negative feedback, push-pull beam power tubes can have a damping factor as high as 10.

Recent designs using triodes with feedback, or Ultra-Linear configurations with feedback, may have damping factors between 10 and 30.

Measuring Damping Factor

The measurement of an amplifier's damping factor is quite simple. This article will describe two more common methods of measurement.

The first method may be called the variable resistance method. A signal from an audio generator is introduced to the input of the amplifier, at a level sufficiently below the point at which output transformer breakdown could occur, with an unloaded output. With the load removed, the output voltage is measured with an audio voltmeter. Then a low value variable resistor such as a 20 ohm wire wound unit is connected across the output terminals and this is adjusted until the voltmeter reading falls to one half the unloaded value.

Under these conditions, the voltage across the variable resistance equals the voltage across the actual output impedance of the amplifier. If the variable resistance is removed, and its value measured, then this value is technically equal to the output impedance of the amplifier. If this value is divided into the nominal output impedance of the amplifier, the result is the damping factor.

Several problems may be encountered with this method. One is that with amplifiers having very high damping factors, it may be difficult to adjust and measure the small values of resistance required to make the voltage drop to half the unloaded value. Another problem occurs when very low resistances are shunted across the output terminals of such an amplifier; the primary impedance of the output transformer may fall to a point where excessive plate current flows and the tubes exceed their rated dissipation.

There is another method which will give the same answer, without the attendant difficulties.

In this method the no-load voltage is measured as was done previously. Next a resistor of a value equal to the nominal output impedance is connected to the output. The amplifier is now correctly matched. The voltage across the output is now measured.

The damping factor of the amplifier is equal to the full load voltage divided by the difference between no load and full load voltages, i.e. =

$$\frac{E \text{ (no load)}}{E \text{ (no load)} - E \text{ (Full Load)}}$$

Damping factor can be considered as the inverse of regulation. If, for example, the output voltage falls only a little when the circuit is loaded correctly, then the regulation is good (low) and the damping factor is high.

If it is found that the output voltage of an amplifier should rise when the load is applied, then this indicates that the amplifier has a negative damping factor.

In this case, if the first method of measurement is used, the resistance value that has to be connected across the output, to cause the loaded output voltage to be doubled, is equal to the negative impedance of the amplifier.

By measuring the damping factor of your amplifier equipment you will be able to evaluate the performance of your amplifier and speaker system, and it will give you an important characteristic of your amplifier.

---

signed to switch any one of up to 25 picture sources to a single monitor, are also installed in these racks. This unit consists of a 25-way uniselector, remotely operated by push button selectors at the viewing positions, and an amplifier. The amplifier restores the signal lost in the resistive splitting networks and also permits the insertion of synchronizing pulses to the signal. The insertion of these pulses at this stage ensures continuity of synchronization during switching. Synchronizing and driving pulses are obtained from a transistorised synchronizing pulse generator type V 3610 through pulse distribution amplifiers type BD 886 C.

In a number of cases, where a controller frequently requires information about adjacent sectors, two monitors are provided. In other cases, only one is installed, a total of 20 monitors being in use. The push button switching unit, mounted next to each monitor, will enable the controller to select the channel, and hence the flight information that he requires. The equipment is specifically designed for continuous stable operation and should require the absolute minimum of adjustment in use.

On Our Bookshelf . . .

The first book we have for review is a Translation of a Russian text.

"Nonlinear and Parametric Phenomena in Radio Engineering," by A. A. Kharkevich.

Published by John F. Rider, Publisher Inc., New York. Dr. Kharkevich is Professor of Theoretical Radio Engineering at the Moscow Electrotechnical Institute of Communication. He is also the director of the Communication Laboratory of the Academy of Sciences of the U.S.S.R.

In this book the author discusses in extremely clear and interesting form the theory of nonlinear systems, and applies this to typical electronic problems. On this account, the book is written for the design and practising electronic engineer.

The development of devices having some parameter which is variable has opened new vistas in solid state electronics. This has been one of the causes for a renewal of interest in the theory of nonlinear systems. In the text are rather sound discussions on the theory of operation of oscillators, the parametric amplifier, the operation of detectors and rectifiers, FM and Phase Modulation detection systems and frequency conversion. Also included in the section under the main heading of parametric devices is synchronous detection systems, and regenerative frequency dividers. Although thoroughly basic, this text has found a place on the reviewer's shelves as a useful reference book, when problems must be tackled from basic details.

Our copy has come direct from the Publishers.

* * *

The second book this month is:—

"Single Sideband Communications Handbook," by Harry D. Hooton, W6TYH. Published by Howard W. Sams and Co. Inc., New York.

Both in amateur and commercial circles, Single Side Band equipment is probably the most commonly discussed and extensively developed part of communications techniques over the last few years, although the basic principles have been recognised and used commercially for fully 30 years.

The text discusses the origin of the Single Sideband communication system, and the means of deriving such a mode of transmission from the commonly used amplitude modulation system. The following two chapters discuss in quite full detail the techniques for suppressing the unwanted carrier, and the methods of removing one and selecting the remaining sideband. The following 4 chapters cover in more detail subjects such as carrier generators, speech amplifiers and filters, balanced mixer and converter systems, and linear R.F. amplifiers. . Other chapters, interspersed throughout the remainder of the book give some details of typical sideband generators, and a few of the most commonly found commercial single sideband transmitters. This is complemented by a section at the rear consisting of a number of fully detailed circuits of commercial equipment.

This is a thoroughly enjoyable book and is a handy addition to others already written on this rapidly developing subject, as it is technically up to date.

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A Six-Metre S.S.B. Exciter

By Irving Spackman, ZL1MO

Interest in S.S.B. on the V.H.F. amateur bands — principally 51 and 144 megacycles — is growing rapidly. This article and photos have been prepared to show how easy it is to modify or add to your existing equipment and try V.H.F. Single Sideband.

It is not really necessary to extol the advantages of single sideband on the high frequency amateur bands between 3 and 30 megacycles, but on the V.H.F. bands, where there is less Q.R.M., more available space, and only the problems of weak signals and noise of various types to contend with, many people do not realise the advantages of Single Sideband. These advantages can largely be summed up as follows:

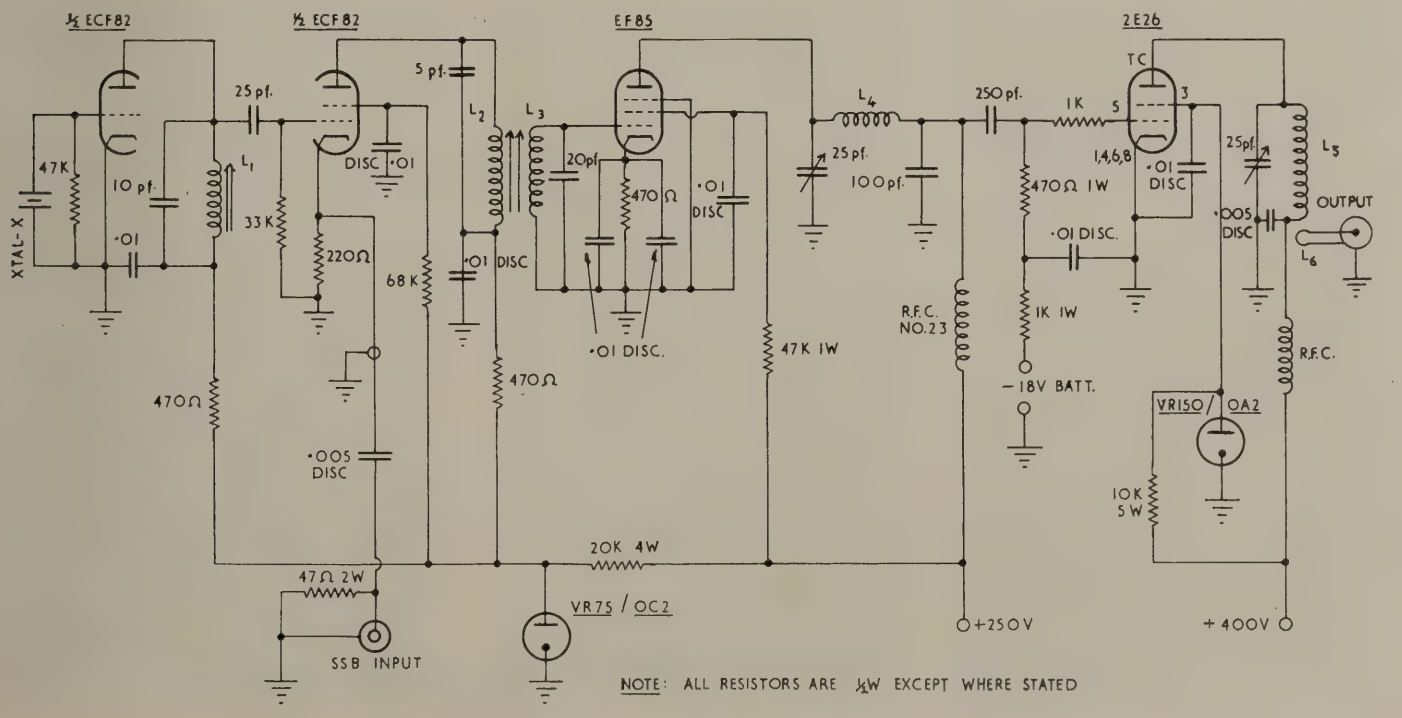
1. In order to achieve high power output with an amplitude modulated signal, a modulater capable of a power output of at least one-half the total input power to the final stage is required. To get such power involves the expense of building a power supply, speech amplifier and modulater together with the cost of a modulation transformer. However, any small exciter such as we are about to describe will drive one or two tubes to the full P.E.P. input permitted for New Zealand amateurs. If this same high power amplifier was used to amplify an amplitude modulated signal, we would find that its efficiency was so poor that an amplifier would be capable of only producing a quarter as much output. provided that the tubes were even capable of dissapating the extra losses.

Thus, single sideband does provide a simple means — perhaps almost the most efficient means — of generating a high power R.F. signal.

2. Both on theoretical and experimental grounds, it has been shown many times that C.W. has approximately 17 db. advantage over A.M., when used over the same path under the same conditions. This means that a transmitter which is capable of transmitting 100 watts of fully amplitude modulated R.F. energy has the same transmitting range as a 2 watt transmitter operating on C.W. This is all well and good, if you want to use C.W. However, it has also been shown that a single sideband signal is nearly as effective as C.W. Actual tests on the 51 megacycle band, have shown that, even though not exactly theoretically true, in practise, a single sideband signal could be copied with the same ease as C.W., when operating over the same path, with the signal strength of the received signal being very weak. Under the same conditions, an A.M. signal was not detectable.

It can be seen then, that S.S.B. has some worthwhile advantages when operating on V.H.F. frequencies.

This article describes a six metre exciter capable of taking a signal from a low frequency S.S.B. exciter and heterodyning its frequency to the operating frequency. Amplifiers are included to raise the power level to between 10 and 25 watts peak, depending on the voltage available to supply the final tube. This power is adequate for local contacts or for driving a higher power linear. It is also adequate to put a potent



signal into VK and 2ZL distucts, when 'sporadic E' conditions allow this type of D.X.

CIRCUIT DESCRIPTION

The exciter, as can be seen from the circuit, consists of 5 tubes, 2 of which are voltage regulator tubes. A certain amount of reduction in parts can be accomplished if only 6 watts of output is required because the 2E26 output tube can be operated in Class A, with Cathode Bias, and no screen regulation. However, if higher power is required, the tube can be operated in Class AB2, with an increase in complexity of circuitry but with an attendant increase in power output.

The first tube, an ECF82, which consists of a triode and a pentode section, is used as a crystal oscillator and a mixer. The second tube, an EF85 is used as an isolating and voltage amplifier to raise the level from the mixer stage which is run at very low voltage and to clean up the signal, removing any spurious beats from the output. This tube has a pi-coupler in its anode circuit to provide an impedance transformation, a certain amount of spurious signal rejection, and a high Q coupling circuit to the grid of the 2E26 power amplifier. This latter tube operates with a semi-passive grid circuit as an aid to stability. With proper layout and socket connections, the tube is perfectly stable when operating under Class A or AB conditions. A lot of the instability problems disappear if the 2E26 has a very low impedance input circuit — in this circuit it has the input shunted by a 470 ohm resistor in parallel with a 100 pf. condenser. Together with a small value of grid stopper, the tube is quite tame under all conditions.

As can be seen in the rear photograph of the unit, there is only one V.R. tube — a VR 75 or the miniature equivalent. In the author's case, the output tube is operated in Class A with cathode bias and no screen regulation.

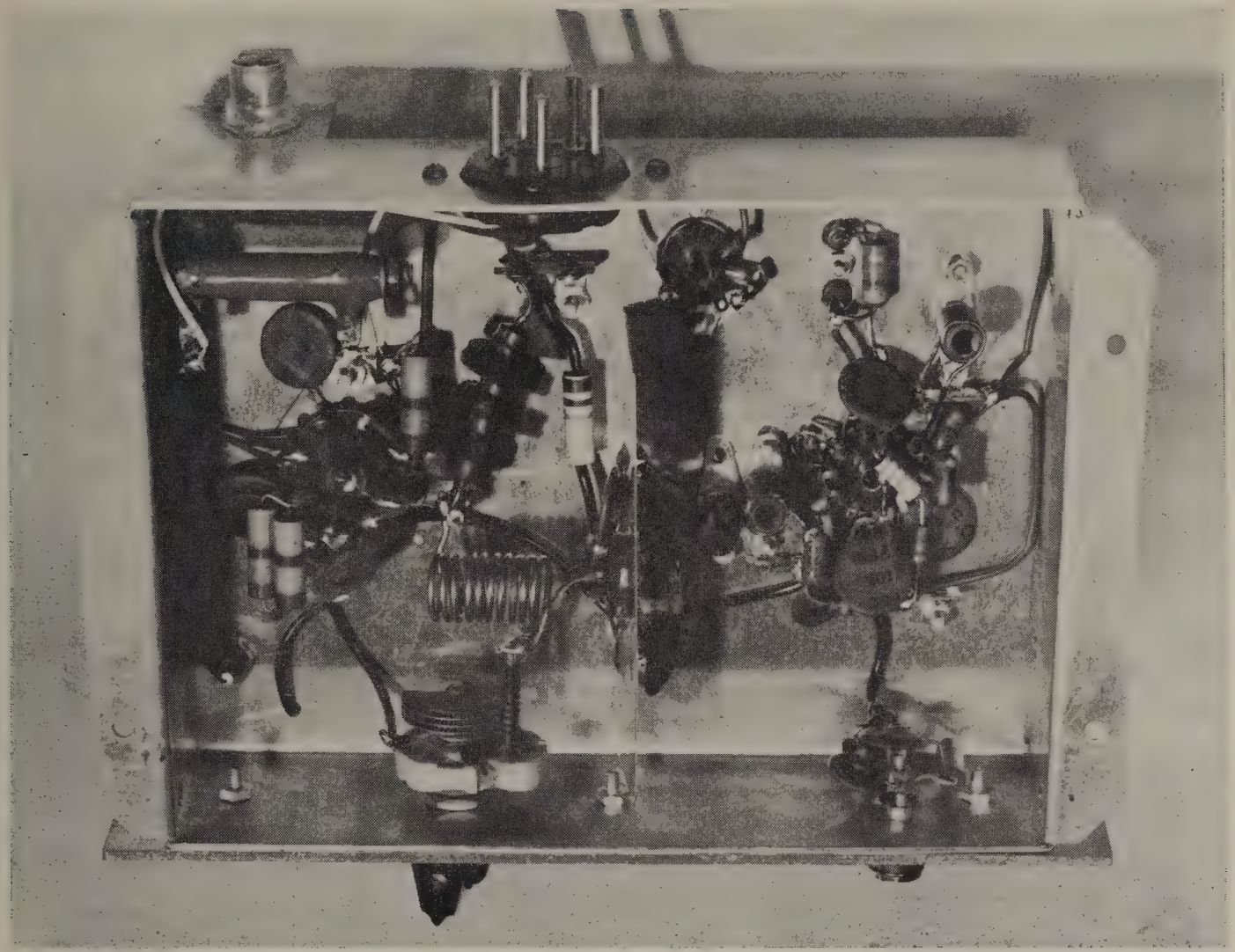
However, for this article, the equipment was modified, to obtain the higher output, and it was found necessary to include another regulator tube — a VR 150 to stabilise the screen voltage of the 2E26.

It will be noticed that the screen and anode supply for the 2E26 are derived from the same source. This is an insurance against supplying the screen with voltage without the anode being so supplied — this could cause damage to the tube.

The crystal oscillator uses a simple grid-plate type circuit with the anode tuned circuit tuned slightly above the frequency of the crystal. Any active overtone crystal will oscillate in this circuit. The author uses a frequency of 46.5 megacycles, a third overtone crystal, which operates very satisfactorily. This fits in with other equipment the author uses. A suggested frequency could be a 37 megacycle unit — these can be obtained through advertisers in this magazine to special order. This would allow the 14 megacycle output of a S.S.B. exciter to be used to drive this unit.

The mixer section of the transmitter uses the pentode section of the 6U8 or ECF82. The signal from the crystal oscillator is coupled to the grid circuit, while the input from the external S.S.B. exciter is coupled into the cathode of the same tube. The screen is bypassed for both frequencies, ensuring the tube operates under stable conditions, a problem often encountered in V.H.F. mixer design.

The output is tuned to the desired frequency, in this case 51 megacycles. A second inductive coupled coil couples energy into the grid circuit of the EF85. This tube is used in preference to the sharp cut-off equivalent — the EF80 — because of its variable gain control facility, and this is used in two ways. By adjustment of the cathode bias resistor, the bias can be set at a point at which adequate drive is provided to the final tube. This higher-than-normal bias, is also helpful in allowing the tube to handle the voltage available from the mixer, which can run up to 4 or 5 volts. This will depend on the voltage supplied to the mixer from the external exciter.



The external exciter need only supply two or three volts across the cathode of the ECF82 pentode for satisfactory mixer service. In many cases a dummy load with a tap on it, or some other system will have to be used, to reduce the level of drive to a suitable value.

The output of the EF85, which is a very high gain tube, will run as high as 60 or 70 volts, when operating into a high-Q tuned circuit. This is 5 or 6 times more than is needed to drive the 2E26. For this reason the pi-network was selected to step down the impedance, and voltage, to a suitable level. The output capacity of the pi-network is the output capacity of the EF85 plus the tuning condenser in the anode plus stray capacity. The output capacity of the pi-network is the 100 pf. silver mica, the input capacity of the 2E26 and strays, all in parallel. This network reduces the available voltage to a suitable level whilst providing a suitable match to the low resistance in the grid of the 2E26.

It will be seen from the circuit that there are a number of cathode connections shown for the 2E26. If the tube is operating with fixed grid bias, each one of these should be earthed with a short, heavy conductor to the chassis. If cathode bias is used, each of these pins should be by-passed with a .01mfd disc ceramic condenser soldered to the respective pins and the chassis or solder lug with the shortest possible leads. The screen should be by-passed in a similar manner.

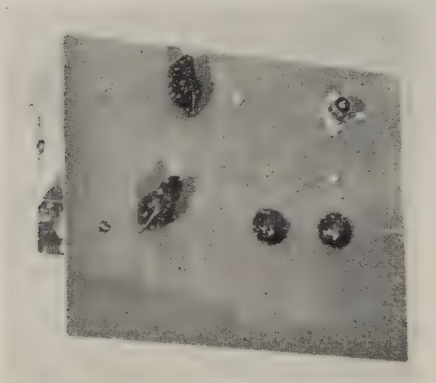
The output tuned circuit consists of a simple parallel tuned circuit with a single turn link acting as a coupling system to the antenna. The L and C valves for this tank circuit have been selected to provide an optimum match from the output impedance of the tube to an antenna of 50 or 70 ohms.

SIDEBAND SELECTION

With the crystal oscillator frequency below the output frequency, as we have it here, and 'additive' mixing up to the desired working frequency, the sideband selected at the output of the low frequency exciter section, will be maintained in the output of this exciter. For example if a megacycle signal is used with the upper sideband selected (normal practice on this band), then the 51 megacycle signal will also comprise the upper sideband. As it is normal convention to use upper sideband on all frequencies above 10 megacycles, direct heterodyning from 14 or 21 megacycles is very attractive.

TUNING UP THE EXCITER

Remove the output tube and apply filament and plate voltage to the oscillator mixer and buffer amplifier sections. Each of these is now aligned carefully in the following manner. The oscillator is tuned by adjusting the slug in the plate coil of the oscillator section until grid voltage is observed on the grid of the mixer using a V.T.V.M. D.C. probe If this is not available listen for the oscillator in a receiver, or use a G.D.O. as an absorption wavemeter as an indicator, coupled very loosely to the plate coil. Tune the coil slightly to the high frequency side of maximum R.F. energy, or the oscillator will not start reliably when power is applied. Also make sure the VR. tube is alright and that all components are operating within their ratings.



Couple in the low frequency exciter and unbalance the controls or wind in a small amount of carrier, sufficient to provide about 2 or 3 volts of drive at the cathode of the 6U8 pentode mixer section. Now listen to the expected frequency in the 51 megacycle region with the antenna removed from the converter or receiver. A healthy carrier should be detected. Adjust the slugs in the plate circuit of the ECF82 pentode and the grid of the EF85 for the maximum signal. Now wind out carrier from the exciter and the carrier on 51 megacycles should also be reduced. If it does not, then you have tuned up on a spurious signal.

If any trouble is encountered, it would pay to check all the coils with a Grid Dip Oscillator prior to final adjustment. Once the carrier on 51 megacycles is behaving itself, then measure the cathode voltage of the EF85, and increase carrier from the exciter again until the cathode voltage of the EF85 just commences to rise. This indicates the point of non-linearity and that the tube is being driven out of the Class A region. At all times, the S.S.B. drive must be kept below this point, otherwise distortion products will increase. The anode circuit of the EF85 can now be resonated — this tuning point will be very sharp. Check to make sure that you are tuning to 51 megacycles and not the oscillator or some other spurious frequency. Once the right position has been found, mark the position on the dial in some way. There will be little need to alter this control again if V.F.O. excursions of less than half a megacycle are utilised.

Replace the 2E26, and plate and screen voltages can now be applied to it. If the tube is operating in Class A, with cathode bias, check the screen and cathode voltages to make sure the bias is correct and the tube is operating within its rated dissapation. If the tube is operating with fixed bias, however, this should be adjusted so that the plate current, at the particular plate voltage is sufficient only to produce about half the tube's rated anode dissapation.

Now the final anode circuit can be resonated. Even with carrier wound out, there should be sufficient remaining to be easily detected in the receiver. Check over all the various adjustments again (including the low frequency exciter) except the crystal oscillator and touch up for maximum signal. Now connect a suitable dummy load such as a 10 watt or 15 watt bulb — depending on the expected power output, and increase the audio gain and other gain controls in the main exciter, to provide the required amount of S.S.B. excitation. The lamp should glow brightly on voice signals, but be completely extinguished otherwise, indicating lack of any spurious output.

The microphone can now be turned down and the receiver used to examine the surrounding spectrum for any sign of parasitic oscillations or instability in the transmission. Only when the operator is completely satisfied, should the transmitter be connected to an antenna.

COIL TABLES

L1	12 turns close wound No. 22 gauge SWG., enamel covered.
L2	14 turns close wound No. 22 gauge SWG., enamel covered
L3	8 turns close wound No. 24 gauge SWG., enamel covered.
L4	11 turns spaced 1 diameter air wound, ¼" diameter, 1" long, 18 G. tinned copper.
L5	4 turns 16 G. enamel copper wire, 1" diameter, spaced, ¾" long.
L6	1 turn link made from inner section of 75 or 50 ohm coaxial cable looped back and soldered to braid.

L1, L2, L3 are wound on OBA or ¼" diamond formers, ¾" long. Slugs are Purple or Black type Iron dust if possible otherwise use Grey Iron dust type.

Final checks on linearity are best made with an oscilloscope and a two tone test. Do not drive the unit too hard — it is only a low power exciter and will not deliver more in this way than it is capable of giving when operated properly. However, it will give a good account of itself both in local and D.X. operation. It will also help where cases of T.V.I. from previous Class C type transmitters have forced the reader to forego operation in the 6 metre band during TV hours. Care should be taken in selecting a crystal frequency, so that its fundamental or harmonics of it, do not fall in the local TV channel. If this is done, the low spurious signal content of this exciter will enable 6 metre operation to be carried out during TV hours except in the deepest fringe areas. As any tendency to overload will occur only on peaks, this usually is not as troublesome as a steady continuous carrier.

CONTROL METHODS AND AMPLIFIERS FOR INDUSTRIAL REGULATING SYSTEMS

W. SPENCE B. Sc., A.M.I.Mech.E.,M.I E.E.

The growth of several parallel systems of control for industrial drives confronts the engineer and technician alike with the problem of what system to use. This article, published by arrangement with Associated Electrical Industries Ltd., will assist all those in the electrical and electronic industry in assessing the relative merits of the various types of equipment available. Of particular interest to our readers will be the sections dealing with valve and semiconductor amplifiers. Nevertheless, many readers with war-time experience will recall rotating amplifiers, such as amplidynes, with pleasure.

The choice between different control systems becomes increasingly complicated as their variety increases. Is there still a case for using magnetic amplifiers and amplidynes? Where does static switching come in? Will it make obsolete all our present-day contactors and relays? The answers to these and similar questions are to be found in sound basic application engineering, which takes into account economic as well as technical factors, and considers the environment and maintainability of the equipment concerned as well as its performance.

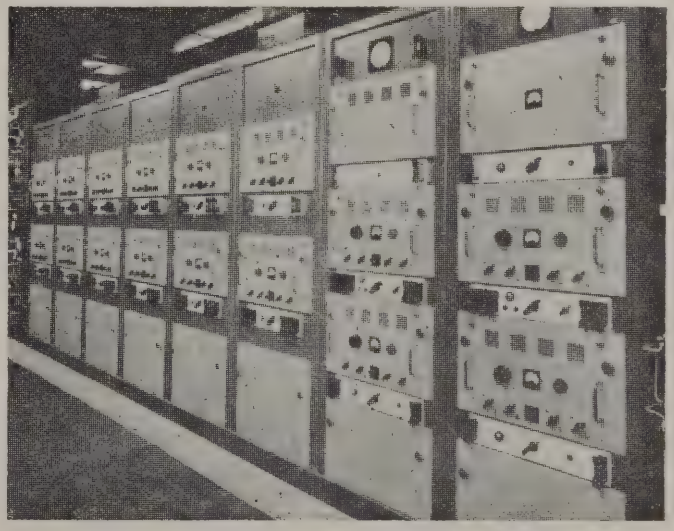
A very high proportion of industrial drives today are controlled by some form of closed-looped regulating system. In such a system the controlled quantity (voltage, current, speed, etc.) is usually measured and compared with a reference quantity at a low power level. The deviation of controlled quantity from reference quantity is then used to provide a signal, which controls the power element of the system in such a way as to reduce this deviation to a small value or to zero. Suitable means of amplification must come before the main power element to step up the power level of the deviation signal. The method of amplification employed requires careful consideration at the design stage of the control system; the selection of methods available at the present time is briefly as follows:

1. Standard d.c. exciters, e.g., rotating machines.
2. Special d.c. exciters, e.g., those with laminated frames.
3. Two-stage, cross-flux excited, d.c. machines, e.g., amplidynes.
4. Thermionic valve amplifiers.
5. Magnetic amplifiers.
6. Transistor amplifiers.
7. Silicon controlled rectifiers (or pylistors).

The historical development of industrial control systems has brought about a parallel development of amplifying devices in line with the increasingly high standards of performance demanded of control systems. Amplifiers have come into use roughly in the order in which they have been listed above for this reason as much as for any other. It was fortunate that new devices such as transistors and controlled rectifiers appeared when they did to enable even more stringent requirements to be met, or alternatively to permit less cumbersome equipments to be devised for the control of industrial drives. Each new device as it appeared has offered advantages over those used hitherto, but it would be a mistake to suppose that there were no attendant disadvantages in the new devices. This article discusses each type of amplifier in turn and attempts to show their characteristics in relation to one another. 'Fashion' is entirely out of place in such a context, and a properly balanced decision can only be taken regarding the type of amplifier to use in any given set of circumstances if the facts of the case are carefully examined. A comparison of the main features of available amplifiers is given in the table.

The rotary amplifier

An ordinary d.c. exciter on a d.c. generator, etc., may be regarded as a power amplifier since the power required to excite its field fully is considerably less (by a factor of, say, 100) than the power which its armature is capable of delivering. Some of the machine's characteristics are good features when it is regarded as an amplifier, while others are bad. For instance, the response of armature voltage to a sudden change in field voltage takes place roughly exponentially with a time constant Tf corresponding to the $\frac{L}{R}$ of the field circuit. Tf can be shortened by, say, increasing R, but this results in a proportionate reduction of the power amplification. In fact, the dynamic amplification factor, defined as the ratio of power amplification to time constant, remains unchanged unless the basic geometry (e.g. air gap length) of the machine is changed. Furthermore, amplification cannot be traded for speed of



1. Electronic excitation panels controlling Ward Leonard generator sets for a paper machine sectional drive at the Wolvercote Paper Mills, Oxford.

POINTS OF COMPARISON	TYPE OF AMPLIFIER							
	ROTATING		MAGNETIC		THERMIONIC VALVE	TRANSISTOR		SILICON CONTROLLED RECTIFIER (PYLISTOR)
	LAMINATED EXCITER	AMPLIDYNE	AUTO-SELF EXCITED	FLUX RESETTER		CONVENTIONAL	MARK-SPACE	
(a) Inherent characterists								
(i) Dynamic amplification	Low	Medium	High for cascade units	High in one unit	Very high	Very high	High	Very High
(ii) Order of maximum power output (kW)	100	10	100	100	0.1	0.1	1	100 and upwards
(iii) Order of typical response time (m sec)	1000	100	100	10	Very short	Very short	Very short	10
(iv) Reversibility of output voltage and/or current in normal use	V and A	V and A	Neither	Neither	Neither	Neither	Neither	Only V
(v) Effect of supply variations	Practically unaffected		Troublesome with single ended units. Push/pull arrangements much less affected		May be troublesome. Stabilised supply desirable in some cases			Troublesome when inverting
(vi) Inherent overload capabilities	Good	Good	Depends on type of rectifier used		Poor	No overload capacity at all		
(vii) Size relative to power output	Medium	Medium	Large but reduced somewhat with increased supply frequency		Small	Small	Small	Very small
(b) Service features								
(i) Durability	Brushes require replacement. Bearings may need renewal at longer intervals		Some rectifier types have limited life		Valve life is limited	Indefinite life. Some probability of failure of components, but steadily decreasing with better design		
(ii) Routine maintenance	Bearings, brushes, and commutator need regular attention		None	None	Regular check of circuit parameters desirable	None	None	None
(iii) Testing and fault-finding	Straightforward, orthodox methods		Circuits can be complicated				Circuits rather more complicated	
			'Built-in' test facilities, and/or module construction with spare units, desirable					
(iv) Availability	Driving motor must be started		No delay	No delay	Valves must warm up	No delay	No Delay	No delay

response with out limit. Eddy current effects in a solid frame set a lower limit to the effective field time constant and interpole lags, largely but not entirely due to eddy currents in a solid yoke, cause commutation difficulties. On the other hand there is no difficulty in obtaining reversal of output polarity, and full use is made of the copper and iron of the machine for either polarity of output. In other words the d.c. exciter is an inherently-reversible amplifier, with a fairly low amplification factor and a rather slow rate of response.

The rate of response of such a machine can be improved by building it with a laminated frame, and this is often done with advantage in quite large d.c. generators and motors. Hysteresis and saturation are other characteristics to be found in all d.c. machines that must be minimised in order to obtain a linear, single-valued input/output relation. The AEI type CX laminated exciter is an example of a d.c. amplifying exciter in which the design of the machine deliberately aims at good amplifier characteristics. To obtain any substantial advance on this type of machine, the two-stage machine must be used.

One of the best examples of the two-stage machine is the cross-flux excited, fully-compensated exciter known as the amplidyne. Thousands of such machines have been installed and are giving excellent service in all kinds of control systems, some under very arduous conditions. The normal working power amplification of the amplidyne is about 2500 to 1, and it has a very good rate of response (being a fully-laminated machine) as exemplified by the time-constants of its two stages, which are of the order of 0.1 second each. In common with all d.c. exciters and generators, it is inherently reversible and has a high ratio of peak output current to maximum continuous current, a useful feature in many control

systems where it is used as a Ward Leonard generator. When used as an exciter, voltage forcing ratios up to 15 to 1 or more are readily obtained by suitable choice of the steady-state operating voltage of the generator or motor field it is supplying.

In certain applications the stored mechanical energy inherent in a rotary amplifier acts as a useful buffer against supply system transients.

What, then, are the draw-backs of such an amplifier? It has rotating parts and, therefore, has bearings which require regular attention. It has a commutator which also requires regular attention and brushes which need to be renewed from time to time. The problem of maintenance must not be overemphasised, however; in a works in which many d.c. machines are already installed, the routine maintenance of a few more amplifying exciters is something which electricians can take in their stride. In some applications the amplification of the amplidyne is insufficient, and in others its rate of response is still not fast enough.

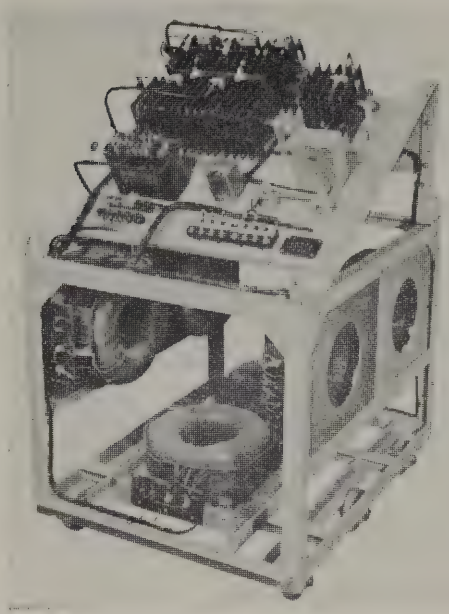
The valve amplifier

In spite of a marked reluctance by industry, and particularly the 'heavy' industries, to admit thermionic valves into their works for process control purposes in the years immediately following the war, certain applications demanded such a high degree of accuracy of control that there was no other solution. Sectional paper-machines requiring 0.1% accuracy of speed control were successfully driven by motors supplied from Ward Leonard generators, which in turn were controlled by amplidynes and thermionic valve pre-amplifiers, or by thyratrons with thermionic valve firing control (Fig. 1). Naturally, the designer's approach to valve circuits for industrial processes must be quite different from the approach required for other applications. Reliability is of paramount importance, and maintenance must not be a lengthy and complicated procedure. The standard of electronic circuit components has been dictated by the radio industry, which is by far the largest user; under industrial working conditions the reliability of these components has often proved inadequate.

The design of industrial equipment with thermionic valves of limited life is therefore particularly difficult when the equipment is intended to control a continuous process with a shut-down charge which can amount to thousands of pounds per hour of lost production.

The magnetic amplifier

In view of the limitations of thermionic valves and of the rotating amplifier, magnetic amplifiers came into use in increasing numbers for industrial control systems some 10 to 15 years ago. These amplifiers employ transductors (variable reactance chokes) and metal rectifiers which were originally selenium but which are now usually germanium or silicon diodes. They are robust, have no moving parts, and require no routine attention. The power amplification per cycle of a single-stage magnetic amplifier is in the region of 100 to 1 and its rate of response depends partly on the circuit configuration

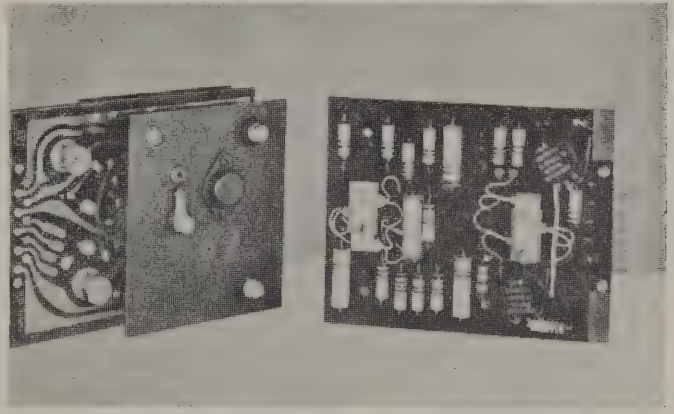


2. A typical magnetic amplifier. Equipment of this type is robust, has no moving parts and requires no routine maintenance. Single stage amplification is in the region of 100 to 1

used. In auto-self-excited amplifiers, the unit function response is not a simple exponential but can be roughly represented by an exponential with a time-constant of 0.05 sec. or longer, when a 50 c/s supply is used. In the case of flux-resetting amplifiers, a maximum delay in response of one cycle is obtained, which means 0.02 sec. with a 50 c/s supply.

A reduction in the bulk and weight of the transductors and an improved rate of response may be obtained by the use of a higher frequency of supply. A fairly delicate design compromise is necessary in the choice of frequency, and the optimum would appear to be in the region of 400 c/s. Where an installation requires a number of magnetic amplifiers, the additional expense of a special 400 c/s alternator with voltage regulator may be justified. The performance of 50 c/s flux-resetter amplifiers, however, is more than ample for the majority of industrial drives.

The magnetic amplifier shares with the amplidyne the characteristics of low input and output imped-



3. A standard transistor amplifier, using printed-circuit connections. A response time of a few milliseconds and an amplification factor of 10^8 are characteristic of such equipment.

ances, and comparative freedom from electrical interference. Because of the presence of rectifiers in the output circuit, on the other hand, the magnetic amplifier is not inherently reversible, and if it is used for a reversing application it usually has to be duplicated in a push-pull arrangement of some kind, which requires each amplifier to be at least double the rating of the field winding constituting the load. This tends to make the magnetic amplifier expensive in such applications.

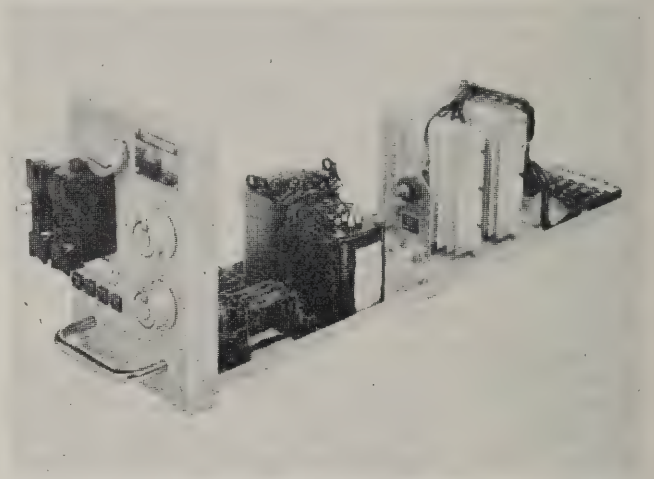
Transient feed-back for stabilising purposes usually involve either transformers or capacitor-resistor combinations. The smooth d.c. output of the amplidyne can readily feed such circuits, but the raw rectified a.c., full of harmonics, produced by a magnetic amplifier, can cause serious degeneration of such an amplifier if transformer or CR feed-back circuits are fed from it. This, however, is the system designer's problem and it can be solved in particular cases.

The semiconductor amplifier

While magnetic amplifiers can be designed for ratings from a fraction of a watt up to 100 kilowatts or more, they are now facing increasing competition from two relatively new devices, the transistor and the silicon controlled rectifier (SCR). The former rivals the magnetic amplifier at the lower end of the power range, and the latter at the higher end. Transistor amplifiers are suitable for outputs up to about a hundred watts, and when designed as standard units on printed-circuit boards (Fig. 3) they can be relatively inexpensive. Their response time is generally a few milli-seconds, and a typical amplifier has a power amplification factor of 10^8. The need for duplication in the event of a reversible output being required is relatively unimportant at the power level in question.

A design difficulty introduced by the use of transistor amplifiers is the need to mix signals by a common electrical circuit; this may be embarrassing when isolation of circuits is required. One solution is to use a low-power signal-mixing magnetic amplifier supplied from a transistor oscillator at 1000 c/s. The separate control windings of the magnetic amplifier provide the necessary isolation and the high supply frequency gives the amplifier a fast response. The power level of transistor amplifiers may be extended by the use of a technique in which the transistor is rapidly switched between the fully conducting and fully non-conducting states. The relative times spent in these two states is varied in order to achieve the desired control of mean output from the amplifier. An amplifier functioning in this mode is sometimes described as a 'mark-space' amplifier. Operation at a higher power level is permitted because internal energy dissipation of the transistor is kept as low as possible, compared with the state of affairs in the more conventional amplifier where the transistor is, in effect, a variable impedance and must dissipate a significant amount of energy when in the 'half-switched' state.

At present, such logic switching circuits must terminate in the opening and closing of conventional contactors in the majority of cases. One notable exception to this is where static switching units are used to sequence the correct selection of reference voltages for the grid-control circuits of mercury-arc rectifiers, which are being used to an increasing extent for the control of large reversing drives. Static switching is already beginning to supplant the use of arrays of sequencing relays hitherto found to be indispensable adjuncts to industrial drive control systems.



4. A typical silicon controlled rectifier (pylistor) amplifier unit. Powers of about 100 kW can be controlled at present, but this limit may well be extended to thousands of kilowatts in the future.

The advent of the silicon controlled rectifier, (pylistor), a solid-state trigger device analogous to the thyratron in its behaviour, has extended the range of power obtainable with semiconductor amplifiers upwards by an unforeseeable amount; at present powers of 100 kilowatts or so are practicable, but with improved pylistors it is possible that thousands of kilowatts may be obtainable in the future. A typical amplifier unit is shown in Fig. 4.

SCR power amplifiers may eventually replace large mercury arc rectifiers, and controlled rectifiers themselves may also replace contactors in many cases. A great deal will depend on the ability of manufacturers to reduce their cost sufficiently by improved manufacturing techniques.

It is already possible to supply reversing d.c. motor drives of relatively small horsepower from controlled rectifiers, with full control of power flow for both motoring and regenerating. Such drives are economic competitors of magnetic amplifier motor drives, but cannot yet compete with Ward Leonard amplidyne drives.

An important limitation of all semiconductor devices, as compared with amplidynes or laminated exciters, is that none of them has any inherent current overload capacity, nor the ability to withstand even a small amount of voltage in excess of their rated P.I.V. (peak inverse voltage), without sustaining permanent damage. Furthermore, their capabilities deteriorate rapidly with increased ambient temperature. The circuit designer, when dealing with semiconductor devices, naturally designs his circuits

continued at foot of next page

A SHORTWAVE CONVERTER

by P. L. WATTS

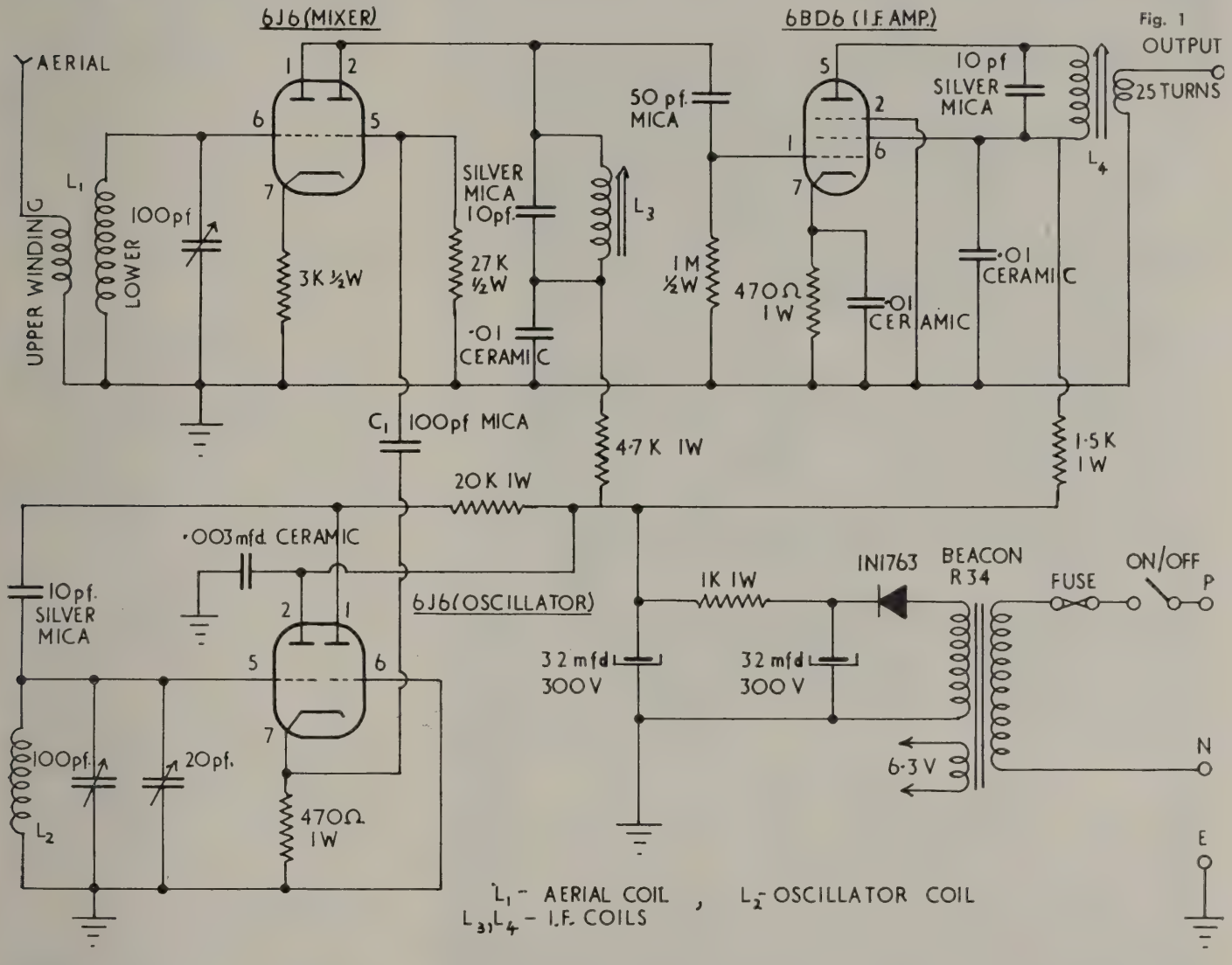
Construction of a band-switching communications receiver needs the careful attention of an experienced technician or amateur and so, to cater more particularly for the beginner, here is a simple plug-in coil converter. This converter, when used in front of even a four or five valve broadcast receiver, will give excellent coverage and reception of short-wave stations all over the world.

No test equipment will be needed for alignment because of the simplified tuning arrangement.

Operation

The converter employs two 6J6 tubes and a 6BD6 in a unique circuit (Fig. 1) made popular by the New Zealand amateur ZL4GP, One of these 6J6 tubes is used as

Fig. 1



accordingly, but in so doing he may be forced to use devices with continuous ratings far exceeding the requirement of the application, in order to ensure their safety under transient conditions. It is, therefore, important to maintain a proper perspective in choosing amplifiers for a given application.

Combined systems

Control systems combining the advantages of the amplidyne with those of semiconductors are often a good proposition. They offer good performance, accuracy of control and speed of response, together with economy and relative simplicity. Circuits containing controlled rectifiers with suitable transistorised trigger (firing) circuits are more complicated, and contain many more components than, for example, an amplidyne and transistor pre-amplifier with equivalent performance. Completely static semiconductor equipment is, of course, preferable when the accuracy of control and speed of response required exceed the capabilities of an amplidyne control system. The important fact to realise, however, is that high performance costs more, either in initial outlay or upkeep, or both. It is not good engineering to install a system with a potential performance far better than the application demands.

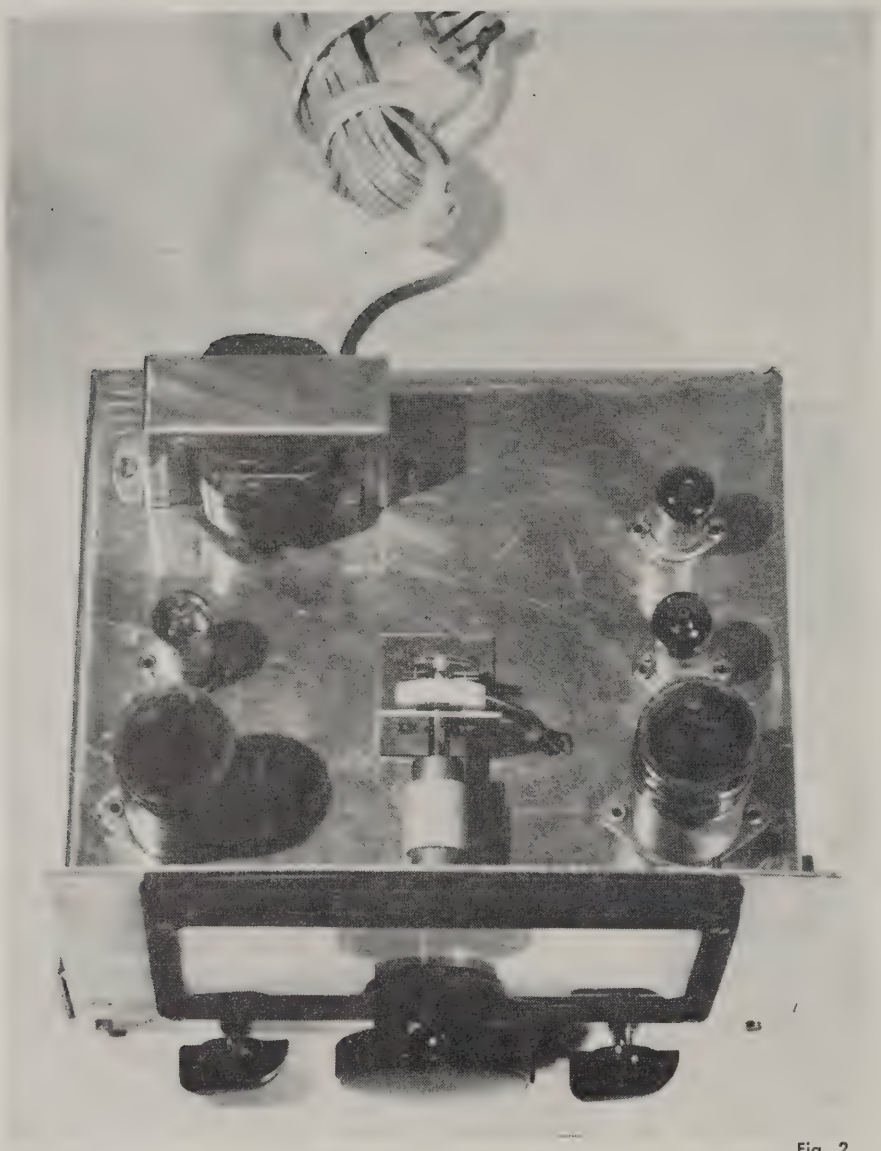


Fig. 2

a two-stage oscillator, while the other serves as an r.f. amplifier and mixer. The signal from the antenna is applied to one of the grids of the mixer, while the oscillator signal is fed to the other grid through capacitor C5. The two plates of the mixer are tied together so that the intermediate frequency (the difference between the oscillator and incoming-signal frequencies) appears in the output. This intermediate frequency (i.f.) is then amplified in the following stage and applied to the output jack.

The i.f. of the converter falls in the upper portion of the broadcast band (somewhere between 1400 and 1600 k.c.). As a result any signals picked up by the converter are reduced to a specific frequency within this range and actually rebroadcast to an ordinary radio. In doing this, all of the amplification of the radio, as well as that of the converter, is being used to increase the strength of the short-wave signals.

The power supply is incorporated on the chassis and supplies 6·3V A.C. for the tube filaments as well as (after rectification through a single diode) 150V D.C. for the H.T.

Construction

The aerial view of the converter in Fig. 2 shows the location of the various components with the plug-in aerial coil for the 40 metre band at the right front corner and the plug-in oscillator coil for the same band on the left. Again on the left hand side, next to the oscillator coil, is the 6J6 oscillator and, on the right hand side, next to the aerial coil is the 6J6 mixer with the 6BD6 i.f. amplifier behind it. The 20 pf. bandspread capacitor can be seen mounted in the centre of the chassis. This should be mounted on a heavy metal bracket and lined up exactly with the vernier dial so as to give smooth tuning.

The exact location of all these parts is not critical and may be changed to suit the constructor's equipment.

Fig. 3 shows the underside view of converter with the 100 pt. bandset capacitor on the left top lip of chassis and the 100 pt. mixer peaking capacitor, on the right. Below the mixer peaking capacitor are the i.f. coils which are just standard broadcast receiver slug-tuned oscillator coils. Before mounting the output i.f. coil, wind about 25 turns of 30 gauge enamelled wire around the end of the form. This can be wound close against the existing winding and then secured by a small piece of sticky tape.

Wiring of the set is straightforward with the usual precautions of short, well soldered leads and careful checking and rechecking to avoid wiring errors.

After construction has been completed it may be found necessary to mount a small piece of shielding metal between the two i.f. coils, as the proximity of the two coils and associated wiring could cause the converter to oscillate.

Coil Winding

Care should be taken in winding the various plug-in coils to make sure that the correct number of turns is used to cover the individual bands. All aerial coils have two windings while the oscillator coils have only one. The six coils for the lower frequency bands are wound on 1¼in. diameter coil forms. For the highest band, commercially available Miniductor coil windings are used. These are wired to standard four (or five) prong plugs or coil-form bases from which the tops have been cut off. Below is a table sup-

COIL — WINDING DATA

BAND	WINDING	AERIAL COIL	OSCILLATOR COIL
80 metre (2.6—6.4 m.c.)	UPPER	30¾ turns close-wound 26 gauge enamelled wire.	18 turns close-wound 22 gauge enamelled wire.
	LOWER	11¾ turn close-wound 26 gauge enamelled wire.	
40 Metre (5.3—14 m.c.)	UPPER	14½ turns close-wound 22 gauge enamelled wire.	10½ turns spaced to occupy $\frac{5}{8}$in. 22 gauge enamelled wire.
	LOWER	4¾ turns close-wound 22 gauge enamelled wire.	
20 Metre (10—27 m.c)	UPPER	8 turns spaced to occupy $\frac{3}{4}$in. 22 gauge enamelled wire.	4½ turns spaced to occupy ½in. 22 gauge enamelled wire.
	LOWER	4¾ turns close-wound 22 gauge enamelled wire.	
10-15 Metre (20—45 m.c.)	UPPER	4 turns of Miniductor type 3014	3 turns of Miniductor type 3014.
	LOWER	2 turns insulated hook-up wire wound over upper Miniductor winding.	

plying the necessary data for winding the coils.

The converter is coupled to radio simply by connecting a piece of hook-up wire from the output jack of the converter to the external aerial connection on the radio. If the radio has a ferrite rod aerial wind about 10 turns of insulated hook-up wire directly over the coil on the rod and connect one end to the output of the converter.

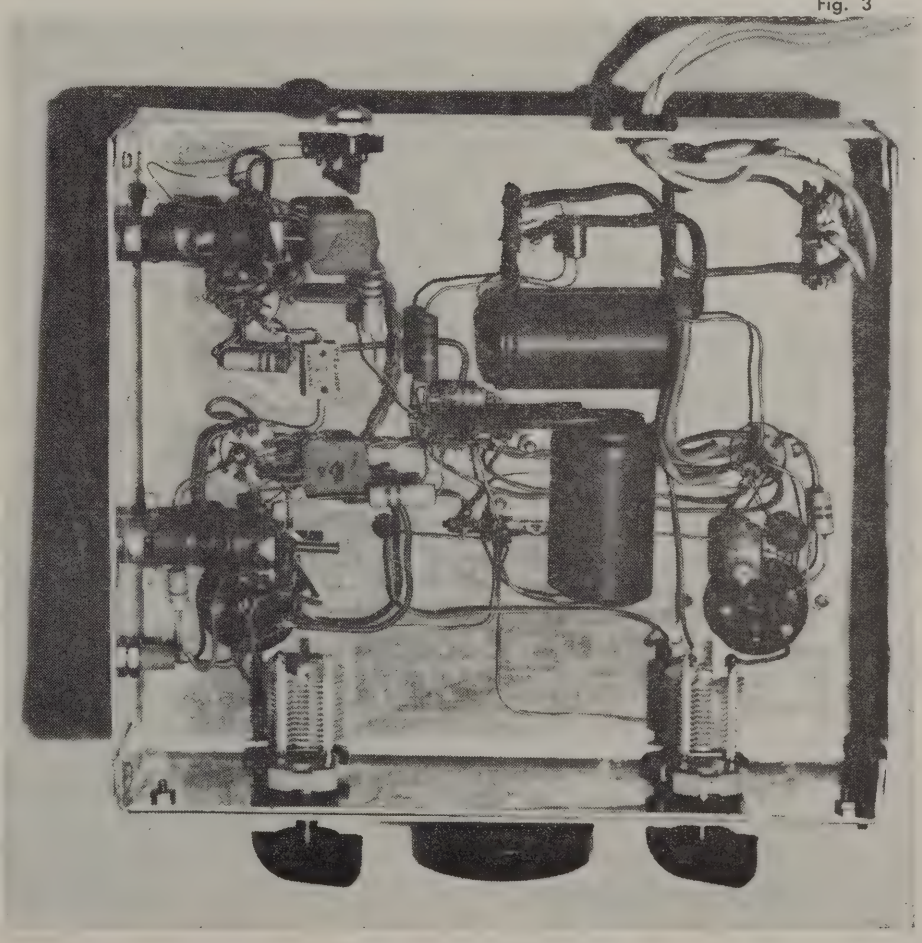
Adjustment

After coupling the unit to the radio and attaching an aerial to the converter, set the slugs of the i.f. coils about halfway in.

Open the band-set and mixer-peaking capacitors to their half-open position and then, using the two 40 metre coils, switch the converter on and rotate the band-spread capacitor. Immediately one of the stronger short-wave stations should come in, then readjust the i.f. coils for the strongest signal and tune the mixer peaking capacitor for maximum volume. Other stations on this band can then be tuned in by merely rotating the bandspread capacitor.

Each set of coils is designed to cover a number of short-wave bands. To tune in a different band with the same set of coils, reset the band-set capacitor and adjust the mixer peaking capacitor by about the same amount. Again tune into a station with the band-spread and adjust the mixer peaking capacitor for maximum volume. The mixer peaking capacitor need not be changed unless the band set capacitor is once more readjusted.

Fig. 3



ATco Standard Power Transformers

FOR RADIO AND AMPLIFIERS, AVAILABLE IN FLAT OR VERTICAL MOUNTINGS

Except where stated all 230 V. Primary

PT	**1**	150/150 V	30 Ma.	6.3 V	2 Amp.			
PT	**2**	220/220 V	40 Ma.	6.3 V	2 Amp.			
PT	**3**	260/260 V	60 Ma.	6.3 V	2 Amp.			
PT	**4**	280/280 V	60 Ma.	6.3 V	2 Amp.	5 V 2 Amp.		
PT	**5**	350/350 V	60 Ma.	6.3 V	2 Amp.	5 V 2 Amp.		
PT	**6**	115/115 V	65 Ma.	6.3 V	1 Amp.			
PT	**7**	115/V ½ Wave	65 Ma.					
PT	**8**	280/280 V	80 Ma.	6.3 V	3 Amp.	5 V 2 Amp.		
PT	**9**	310/310 V	80 Ma.	6.3 V	3 Amp.	5 V 2 Amp.		
PT	**10**	350/350 V	80 Ma.	6.3 V	3 Amp.	5 V 2 Amp.		
PT	**11**	310/310 V	100 Ma.	6.3 V	4 Amp.	5 V 2 Amp.		
PT	**12**	350/350 V	100 Ma.	6.3 V	4 Amp.	5 V 2 Amp.		
PT	**13**	310/310 V	125 Ma.	6.3 V	4 Amp.	5 V 3 Amp.		
PT	**14**	310/310 V	150 Ma.	6.3 V	5 Amp.	5 V 3 Amp.		
PT	**15**	400/400 V	150 Ma.	6.3 VCT	5 Amp.	5 V 3 Amp.		
PT	**16**	400/400 V	150 Ma.	6.3 VCT	2 Amp.	5 V 3 Amp.	6.3 V 4 Amp.	
PT	**17**	450/450 V	150 Ma.	6.3 VCT	2 Amp.	5 V 3 Amp.	6.3 V 4 Amp.	
PT	**18**	450/450 V	200 Ma.	6.3 VCT	2 Amp.	5 V 3 Amp.	6.3 V 4 Amp.	
PT	**19**	500/500 V	200 Ma.	6.3 VCT	2 Amp.	5 V 3 Amp.	6.3 V 4 Amp.	
PT	**20**	595/595 V (500 V DC)	350 Ma. Choke Input					
PT	**21**	890/890 V (750 V DC)	250 Ma. Choke Input					
PT	**22**	295/295 V	360 Ma.	6.3 V	10 Amp.	5 V 3 Amp.	Sec. Tapped 240/240 V	
		Suitable for use with either RCA or Philips TV Kits Primary 0.210, 220, 230, 240 V.						
PT	**23**	Deleted						
PT	**24**	Pri. 0-230-270 V		6.3 V	5 Amp.	6.3 V 5 Amp.	5 V 2 Amp.	
		Used in TV Receiver with Mains Rectification.						
PT	**25**	115 V 360 Ma. 12.6 V 5 Amp. CT used with Silicon Diodes in Voltage Doubler Circuit.						
PT	**26**	280/280 V	80 Ma.	6.3 V	4 Amp.	6.3 V 1 A.		
PT	**27**	280/280 V	125 Ma.	6.3 V	5 Amp.	CT 6.3 V 1 A.		
PT	**28**	280/280 V	175 Ma.	6.3 V	4 Amp.	CT 6.3 V 4 A.	CT 5 V 3 A.	

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The Domestic Stereo System

PART 4

Last month we were unable to feature this part as we had promised. This was mainly due to some further development work we were carrying out on this equipment, and consequently we were unable to have the photographs completed before the publishing date. To those who have been following this series, we offer our apologies, but we feel that the delay would not ultimately cause much trouble.

In the July issue we showed a circuit for the full range of input control facilities. However, in transposing the working equipment to the drawings for publication, two small errors crept in, and should be corrected, if the wiring has been finished before this issue arrives. These are as follows: L.H.S. co-axial input. Switch position No. 3 should connect to wire running down to lower half of circuit from R.H.S. switch position No. 4. Also the wire running to the Right hand side upper and lower switch sections from the upper 220 k resistor and connecting to No. 3 section in both the top and bottom sections, should of course be the moving contact and not connected to any particular contact at all. To avoid any trouble we have published the correct circuit on page 27.

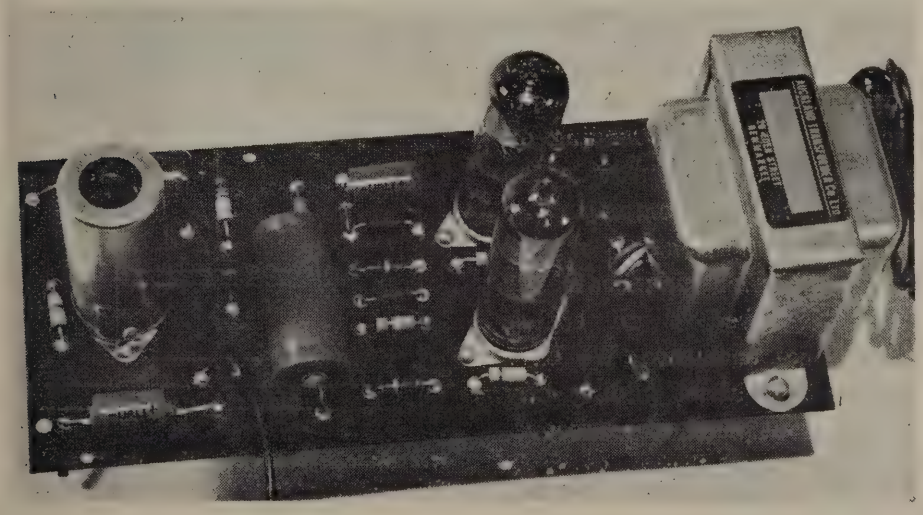
Now to continue. Previously we showed a sub-panel view of the wired board which makes up one section of the stereo amplifier. This, together with the numbered plan, should enable readers to complete the sub-panel wiring. Also, we published a top view plan showing the relative position of the components which are mouted on the upper side of the board. To enable readers to get the complete picture on this part of the assembly, we have published a photo of the layout of the top of the panel. This, together with the other plans and photos, should enable our readers to complete the wiring of the two boards needed to make up the stereo system.

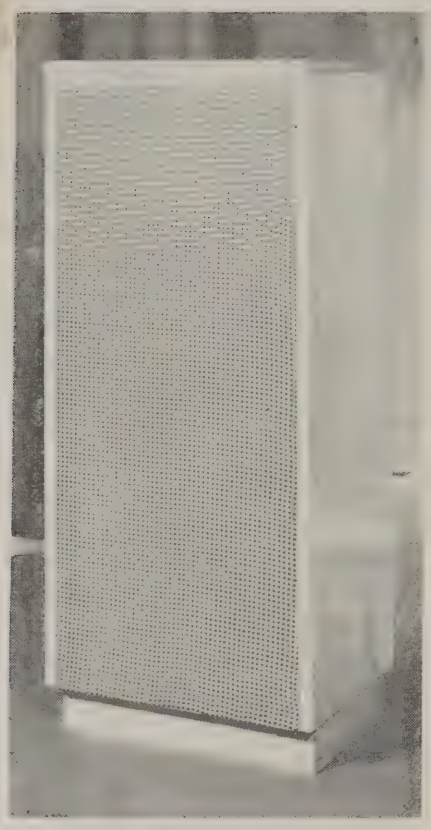
In our July issue we stated that we were going to publish a diagram of a small sub-board for the tone control circuits. It is in this section that we have been carrying out a little more development, as was mentioned earlier in this section. In our original design, we were using two ganged potentiometers of fairly small dimensions. The small tone control board we originally designed fitted the components around these two controls quite easily.

During the course of our investigations into availability of components, we discovered that the type of ganged potentiometers which are now most readily obtainable, were considerably larger than the ones we had used previously. This necessitated a revision of the layout of some of the components. We also decided to utilise ¼ watt 5% high stability resistors in the tone control network rather than ½ watt variety we had used previously. This enabled us to save a considerable amount of space, but unfortunately meant that the board would not be ready for photographing in time to catch this issue.

When each amplifier has been completed, and checked against the circuit it can be tested, preferably with an audio oscillator, oscilloscope, output meter and distortion meter. Many of our readers will not have such equipment, and a listening test will have to suffice. It will be necessary to check the connection to the negative feedback line. This can best be done by using the proper instruments, however it can be determined if it is operating correctly, by ear alone.

With the power supply and speaker connected, feed in some signal to the input of the amplifier. This can be obtained from a





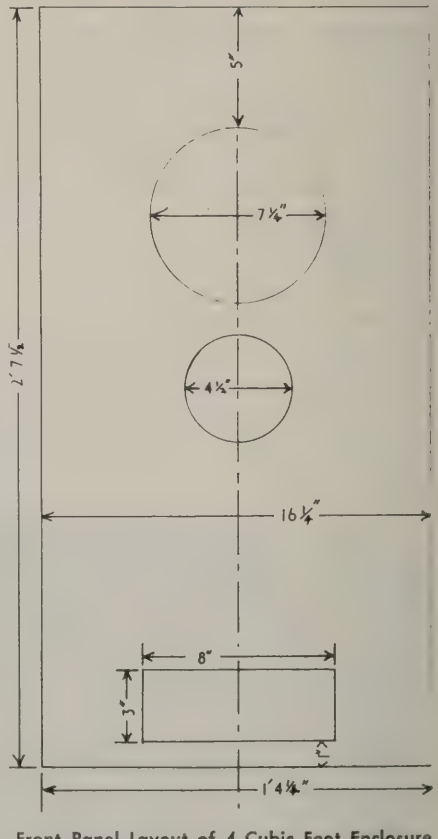
pick-up, or a little signal can be obtained by tapping off about 1/10th of a volt of 50 cycle A.C. with a resistive divider connected across the filament line. With a comfortable level emanating from the loudspeaker, touch the feedback resistor into circuit. If the volume of the test signal is reduced, the phase of the feedback voltage is correct. If however, the output from the loudspeaker increases, or the amplifier breaks into oscillation, emitting a loud howl, the feedback is positive and must be reversed. This can only be correctly accomplished by reversing the plate and screen leads on the 2 output tubes, that is, change the plate and screen leads connected to one tube across to the plate and screen pins on the other tube and vice versa. This should now produce the right result.

A Four Cubic Foot Enclosure

For those who require a cabinet with a lower bass resonance than could be achieved by the small cabinet, we described in the July issue, we have given details of the front panel speaker layout and port dimensions for our 4 cubic foot enclosure. This enclosure is built round a "Personality" Kitset No. 113, using the 13¾ in. deep unit. The back is covered with the hardboard supplied, with a piece of 1 in. coreboard, cut to the right size to slide inside the carcase frame fixed firmly onto the hardboard, which is used only as a fastening medium. By mounting the back in this manner, we found that there was no need to include any felt damping, but it may be necessary in other cabinets depending on the wood which has been used.

It will be seen that the port is now located at the bottom of the cabinet in the usual manner whilst the woofer is located at the top of the cabinet. Just below the woofer, mounted on the centre line, is the 5FX tweeter.

This cabinet will handle a 12 inch woofer if it is desired to use a larger speaker with a lower cone resonance. However, it will be necessary to alter the port size to compensate for the increased cone area, to maintain the loading on the speaker and to provide the correct accoustic damping. The assembly of the cabinet is carried out in a similar manner to the method described for our earlier 2 cubic foot enclosure. We have used the basic kitset, adding only our own front panel, of coreboard- rather than solid timber, to avoid cabinet resonance effects. If the assembly instructions which come with the kitsets are followed faithfully, and a little care is taken with the nailing, screwing and finishing, then the reader will have a neat and yet efficient enclosure. Care should be taken when a piece of material is selected for the front panel, whilst it naturally must look attractive, and blend in with the other furnishings in the home, it should be of an open weave so that it does not introduce too much additional air damping, which will tend to affect the high frequency of the enclosure. Even when an open weave is selected, the material over the speaker openings and port can be seen to move, when low frequency notes are being reproduced. This shows the effect that the cloth will have on the higher frequency end of the range but which is not so easily observed.



Front Panel Layout of 4 Cubic Foot Enclosure using Rola 8M and 5FX Tweeter, suitable for use with Personality Kitset No. 113 Frame.

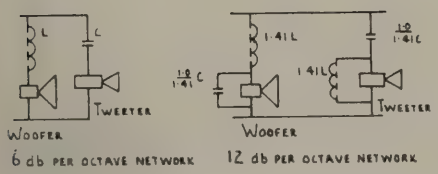
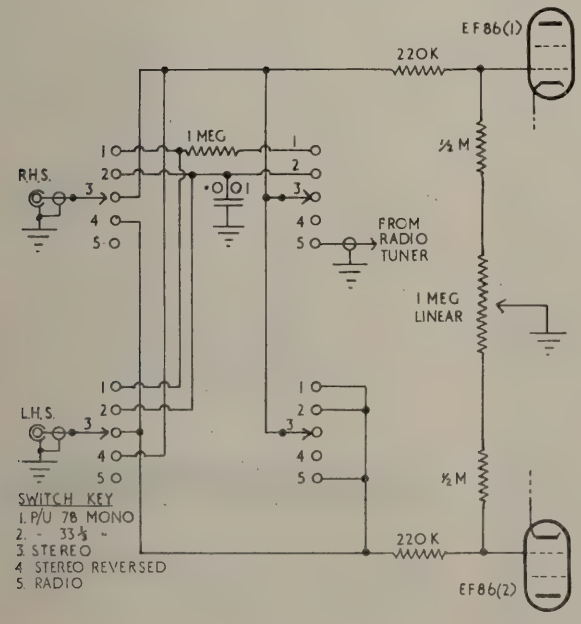


FIG. 4. 6 db. per octave network.
12 db. per octave network.

For the convenience of our readers who may not have access to our December 1961 issue and the article on Hi-Fi crossover networks, we have reprinted the circuit shown in Figure 4 of that article.

In the third part of the article in the July issue we described suitable components for a 12 db per octave network. The circuit for this network is shown on the right hand side of the two networks we have re-printed. This type of network will give excellent performance when used in the 4 cubic foot enclosure. Full attention must be paid to phasing the speakers, and maintaining this information right back to the amplifier. Details of the method of determining the correct phasing were also outlined in the July issue.

At this point we must close. In our next issue we will show the finished amplifier and the new modified tone control network mounting board.



Corrected Circuit.

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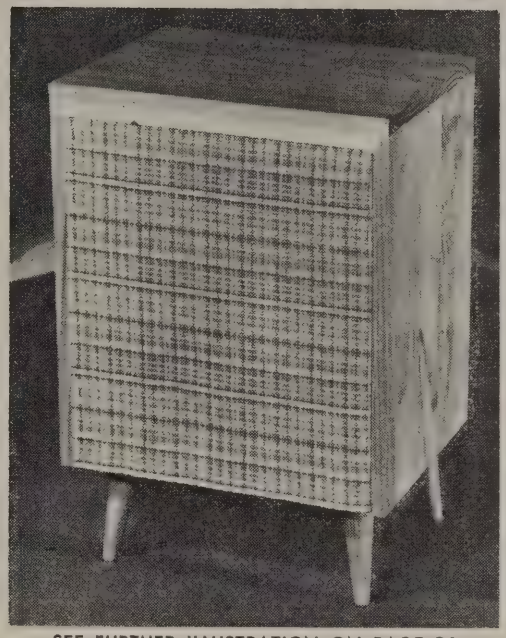
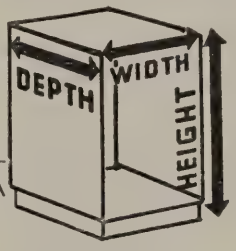


SEE FURTHER ILLUSTRATION ON PAGE 26.

- **THREE LEG STYLES** — a choice of either kick board, peg or Swedish — AT NO EXTRA COST.



- **FULL SOLID BOTTOMS** — for added strength.
- **FREE GLUE** — in handy after use containers.

NOTE: Height of units on Peg legs increased by 3" on measurements given.

UNIT No.	OVERALL HEIGHT	OVERALL WIDTH	DEPTH	PRICE
C21 Incl. Base	24"	18"	14"	48/–
C1 "	30"	"	"	54/3
C3 "	36"	"	"	57/6
C5 "	42"	"	"	76/3
C71 "	24"	24½"	"	64/3
C73 "	30"	"	"	70/9
C75 "	36"	"	"	74/–
C77 "	42"	"	"	80/9
C23 "	24"	35-3/16"	"	71/–
C7 "	30"	"	"	77/9
C13 "	36"	"	"	81/9
C15 "	42"	"	"	89/3

19" DEPTH ALSO AVAILABLE.

To find actual interior measurements deduct 6" from heights and 1⅝" from widths shown above.
Above prices include hardboard backs but do not include any front Panel.

Personality Retailers are throughout N.Z.

Manufactured by:
STOW & SADGROVE LTD., Pukemiro St., Auckland, S.E.5.

LOOKING AT

Long Range TV Reception

To the average TV enthusiast, the normal range at which TV stations can be received depends on the location of the TV transmitter and receiver, the type of antenna system, and the topographical nature of the country, but it is normally not greater than, say, 100 miles, under average conditions. It comes as somewhat of a surprise therefore, to learn that TV signals span much greater distances — up to say 1500 miles — under favourable but spasmodic conditions.

We intend this month to outline some of the reasons for this anomalous propogation, in view of the fact that such effects will be most noticeable in this country in the forthcoming summer, particular over the December-January period.

Although there have been odd occasions to the contrary, generally speaking, the TV stations in Band 1, that is, the region 40 to 70 megacycles, are the ones which exhibit this anomalous propogation. In New Zealand, at the present time, there are no high powered TV stations radiating in Band 3. However, overseas stations operating in this region, i.e., from 160 to 220 megacycles, have been seen and heard over distances of 1000 miles or more. This is very rare, and is brought about generally by a different mode of propogation from that which caused the Band 1 signals to span long distances. Some time ago there was one occasion when Australian Channels 7 and 9 were seen and heard in Auckland. However, this cannot be compared with the number of times that the Australian Channel 2, operating from the main centres, has been received in this country.

The Mode of Propogation

To understand the reason why these very high frequency signals, which normally follow line of sight paths and penetrate the ionosphere, became refracted back to the earth's surface at distances of 800 to 1500 miles, we must study the ionosphere and its behaviour in the summer months.

The ionosphere itself extends about 25 to 250 miles above the earth. It is produced by bombardment and consequent ionization of the molecules of the upper atmosphere by the ultra-violet rays from the sun. A study of the density of this ionization shows that there are bands or regions of maximum ionization but with no markedly defined boundaries.

In Fig. 2 we see a diagramatic representation of the various ionized layers of the ionosphere on a summer day. As can be seen, they are called — starting from the band closest to the earth's surface, the D, E and F layers.

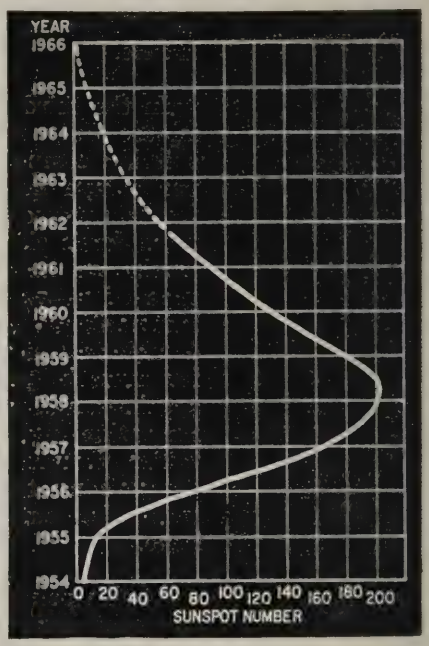
During daylight hours, the D layer is centred around 40 miles above the earth; the E layer, centred about 75 miles; and the F layer, for convenience, divided into two regions, F1 and F2; is located about 150 and 200 miles above the earth respectively.

During the night the D and E layers merge and move higher to about 80 miles, whilst the F1 and F2 combine and rise to between 200 and 250 miles.

Depending on the density of these various layers, we can get absorbtion and refraction effects from them. The intensity of the ionization of these layers also dedepends on the state of the sun–in particular, the number of sunspots which appear on the gaseous surface of the sun. At periods of high sunspot activity, such as we found in the years 1957 - 1959, frequencies exceeding 50 mc/s were regularly returned to the earth over many paths.

In figure 1 we show a graph of the sunspot numbers for each year. These have been plotted up to 1962 and the remainder of the graph has been forecast from the characteristics of the sunspot maximum-mimimum cycles, which have been collated for many years. It will be seen that the sunspot number is dropping year by year

Fig. 1. Sunspot cycle from 1954 to 1962 (solid line). Values to expected sunspot minimum in 1965 (dashed line).



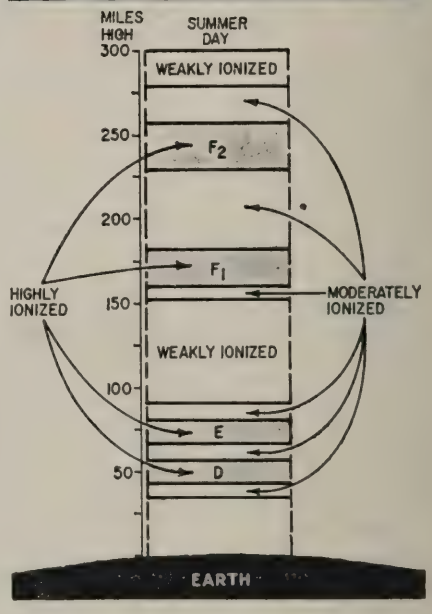


Fig. 2. Ionosphere layers on a typical summer day. Most long-distance, high-frequency communication takes place via the F-layers, most ionospheric absorbtion occurs in the D-layer.

to a predicted minimum in the year 1964/65.

It has been found that particularly in the times of sunspot minima, there occurs a phenomenon called sporadic 'E' ionization. The effects of this abnormality in the E region of the ionosphere is the periodic — often sudden — appearance of drifting electron clouds, in which the ionization is much higher than normally found in the E layer. These clouds may be quite small, or they may extend over hundreds of miles. These layers of electron clouds are therefore given the name of "sporadic E" and they seem to occur most frequently during summer nights, but are quite unpredictable and can occur at any time of the day or night.

These clouds possess sufficient ionization to refract very-high-frequency signals in the frequency range 40-70 megacycles, back to the earth, whereas these signals normally penetrate the E and F layer and travel on into space. The bending effect is such that the signals return to the earth at a distance of from 800 to 1500 miles away from the transmitter.

If the ionization level is very high, and the layer is "dense" then the "wave fronts" of the V.H.F. signals are bent sharply and return to earth at distances of 800 miles or so. If however, the ionization is weak, then the wave is only just returned back to the earth, and at a distance of about 1500 miles.

Characteristics of a Signal Propogated by 'Sporadic E' Ionization

To catch this phenomenon, one must maintain a careful watch on any channels which carry transmissions which are radiated from transmitters within the 800 to 1500 mile range.

In New Zealand there is every possibility that Channel 2 Dunedin could be observed in Auckland on Channel 2 and vice versa. Also all parts of New Zealand are within suitable distance of the TV stations operating on the Eastern side of the Australian continent. The signal will manifest itself as either the sound or vision coming through, often very weakly at first. In some cases, the sound carrier may be propogated and not the vision signal or vice versa. With receivers using inter carrier sound systems the sound signals could be present and not observable unless the vision was also present to produce the necessary intercarrier "beat".

Over a period the signal will usually build up in strength, often going into very deep fades followed by peaks of high signal strength. These variations are due to multipath propogation of signals which arrive in or out of phase with one another and either tend to enhance or cancel each other

As the sporadic E cloud moves into a position which provides the optimum refraction angle for the particular areas, the fading becomes less, but often quickens in rate of rise and fall of strength. Under such conditions one or more stations may be heard with the strength signal taking control of the receiver accompanied by beats produced by the presence of the other signals. Often with multistation reception, one station's video will be accompanied by another station's sound transmission. There is nothing more intriguing than watching a show, to the accompaniment of a cricket or tennis commentary.

As conditions become less suitable, the fading will increase, the signal strength will drop, and finally transmission will disappear often to be replaced by a signal from another station.

During these rapid signal excursions, there are often large variations of contrast, and in many cases the multipath transmissions give rise to severe ghosting and picture distortion. In other cases, particularly when the signals are stronger, the picture quality is as good as reception from a local transmitting station.

Another Propogation Medium

There is another way in which enhanced signal strengths can be obtained over distances longer than the normal groundwave propogation range, but shorter than the distances spanned under "sporadic E" reflections. This is a phenomenon called "tropospheric bending" or "tropospheric ducting".

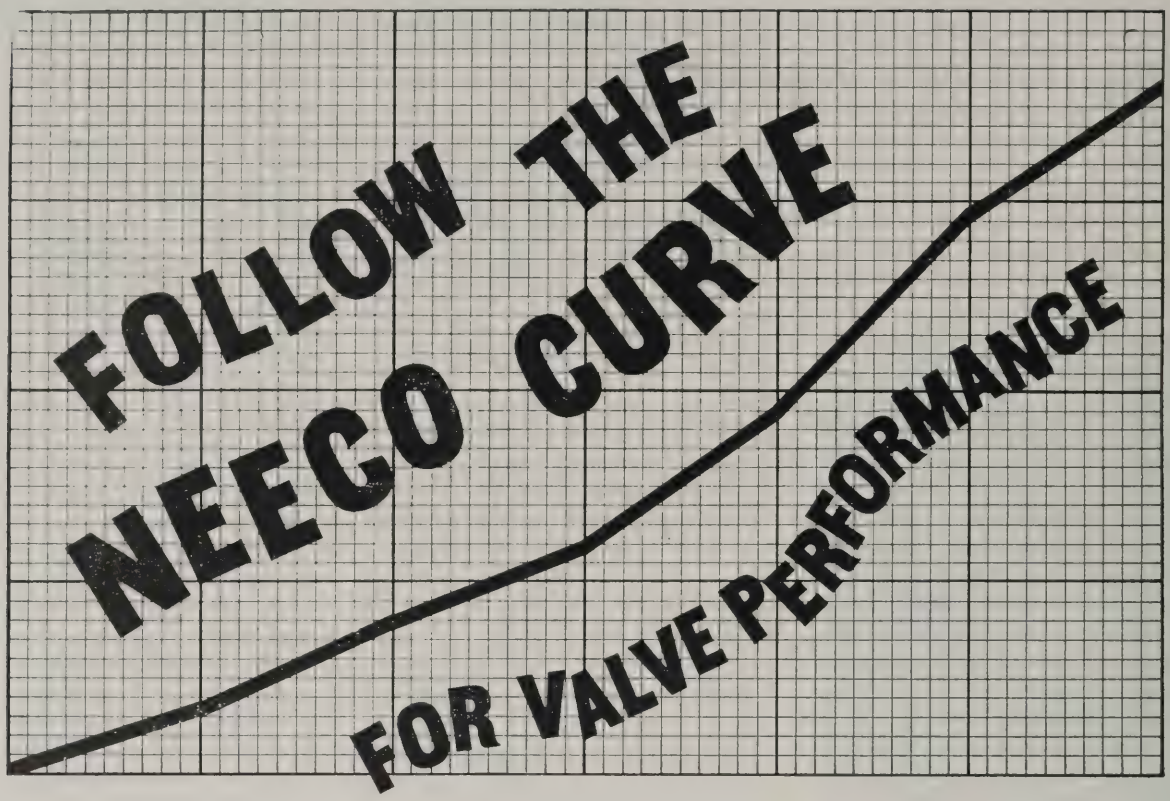
When we examine the temperature of the air above the earth's surface we find that the temperature normally drops lower and lower as we go higher in altitude. Due to unusual weather conditions, it is possible for a mass of warm air, which will be of high moisture content to be driven above the air situated at a higher altitude, and which is colder and carrying less moisture. In this case we have a condition known as "temperature inversion".

The boundary between the two layers of air produces a variable refractive index and can cause bending of V.H.F. signals sufficient to cause them to return to earth. In this case we get signals enhancement over paths of 200 to 500 miles in length. A typical example of this is Wellington Channel 1 being received at good strength in Auckland or Dunedin. This propogation condition will also cause bending of signals in the high band channels as well.

If the layer which is warm, lying between the two colder regions, is very thick, the combination of these can produce the effects of a waveguide or duct. Once signals penetrate the walls of this duct. they pass along it, being reflected from each side, in many cases with very little loss of signal strength. Where the duct finishes, or where one side of the duct becomes thinner, the signal will propogate out of the duct — possibly returning to earth. This phenomenon is called "tropospheric ducting" and is more likely to occur at the higher frequencies of band 3 transmissions.

This is probably the reason for the long range reception of Australian Channels 7 and 9 here in New Zealand. However, the suitable weather conditions over distances of this magnitude are not found very often, but propogation over 200 to 500 mile ranges of signals by tropospheric bending occurs rather more frequently.

This concludes this summary of unusual propogation affects on TV frequencies. We would like to receive any information from readers who, over the current summer months receive any unusual TV transmissions from other centres in N.Z. or from overseas.



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V2.1

Overseas Notebook . . .

Britain's Smallest Indicating Meter:

Claimed to be the smallest edgewise meter ever produced in Britain, a new a.c., d.c., volt/ampere meter has been announced by a U.K. firm.

The meter, which measures across its face 1 6/8 in. x ½ in. is for use in modern electronic equipment where space is at a premium.

Ranges covered at 10 milli-volts to 1000 volts d.c., and from 5 volts to 1000 volts a.c. Current measurements range from 50 micro-amperes to 1 ampere without the use of an external shunt.

Typical applications include: digital indicators, tape recorder output monitors; signal-meters for transmitters and comparators for dual circuits.

Taylor Electrical Instruments Ltd., (M.I. Group), Slough, Buckinghamshire, England.

* * *

Circuit Cuts TV Warm-up Time

A novel circuit arrangement devised by Mullard engineers is said to cut "warm-up" time of a television set from the usual one minute to less than 15 seconds. The circuit is simple and needs no extra components in the set, but merely an "ON-OFF" switch with three positions instead of two. In the extra, or "Stand by", position the high voltages within the set are switched off, but the heaters of the valves and tube are maintained at half power so that when the switch is turned to "On" the heaters very quickly attain their correct operating temperature. Once the set has been warmed-up initially it can be left switched to "Stand by" during intervals between viewing, ready to give picture and sound almost immediately it is switched fully "On". Used fully, the quick heating circuit would add about a penny a day to the viewer's electricity bill. The firm say it has a negligible effect on the life of the valves and tube.

(Mullard Ltd., Mullard House, Torrington Place, London, W.C.1.)

British Technicians Pioneered Methods for Telstar Operation:

Much of Britain's share of the Telstar operation to bounce radio and TV signals across the Atlantic by way of a satellite started from scratch a year ago sibility for the British end of the experiment. Major component in the transmitwhen the Post Office undertook responter equipment was a valve developed by the Admiralty — said to be the most powerful in the world. But on the electrical side engineers of Associated Electrical Industries worked against the clock to build and install the transmitter's output within six months.

The Admiralty valve is a travelling wave amplifier which can give a maximum power output of over 5 kilowatts — more than twice as great as that of the valve used in the American transmitting station.

In the new valve a radio wave is made to travel along a conducting circuit at a speed very much less than that of light, and a beam of electrons is shot through it at an approximately equal speed. The radio wave first causes the electrons to cluster into bunches and then slows them down. As the electrons are decelerated they give up some of their energy to the radio wave, which is thus amplified. The valve has a current of one ampere and a voltage of 25,000 volts. The radio signal is introduced at a level of about three watts.

Because the speed at which the radio wave travels along the circuit does not depend very greatly on its wavelength, the travelling wave tube of this type can amplify a wide band of wavelengths — necessary for transmitting a television signal or a large number of simultaneous telephone conversations.

A.E.I.'s apparatus was completely designed and built by the company's electronic apparatus division.

The equipment provides 4KW of power to the aerial at a frequency of 6,390 MC/S with a signal band width of 100 MC/S. For operating the travelling wave tube high power amplifier there are three stabilised 'extra high tension' power supplies for the valve electrodes, magnet and cathode heating supplies. Water and air cooling systems are also included. The apparatus is housed in cubicles installed in the cabin of the aerial turntable.

Space Fuel Cell for U.S. Air Force:

The Westinghouse Research Laboratories has contracted to develop for the United States Air Force a unique "solid-state" fuel cell for generating electric power in space. Such fuel cell requires no pastes or liquid chemicals to produce its "chemical" electricity.

The solid-electrolyte fuel cell operates at high temperatures, about 1850 degrees Fahrenheit. At such temperatures certain inorganic, ceramic-type materials can be substituted for the electrolytes used in low-temperature cells.

Purpose of the electrolyte is to carry charged atoms (ions) between two electrodes — one positive, the other negative — this producing an electric current.

Refractory-Type Materials Used in Cell

The solid-electrolyte fuel cell uses materials such as zirconium and calcium oxide mixtures, which are chemically related to the refractory materials used in lining the walls of high-temperature furnaces. The cell's fuel is hydrogen, methane or other gas, which flows through a chamber containing the negative electrode. Similarly, oxygen gas is fed continuously to the positive electrode. The electrodes are metals such as platinum and nickel, which are capable of resisting high temperatures and chemical attack by the hot gases. Electrons attach themselves to the oxygen, forming ions which move through the oxide electrolyte. At the negative electrode they combine with the fuel, freeing the electrons to the process. Laboratory versions of such solid-electrolyte fuel cells have exhibited current densities of more than 100 amperes per square foot. At low-current densities, the cells have been operated continuously for periods longer than two months with no noticeable deterioration.

Scientists will investigate the technical problems imposed by space applications, including those which arise in operation of the cell under conditions of weightlessness and high vacuum. The problems of ruggedness, light weight, reliability and cell life also will be studied.

Shortwave Survey

MIKE BUTLER

TEST CRICKET IN AUSTRALIA

Radio Australia has announced details of the arrangements for the test cricket commentaries which are one of the most popular of all the sports features in world broadcasting. Here in N.Z. I have even had them given as the sole reason for owning a S.W. radio set! The dates for this series are: First Test at Bribane, 30th November to 5th December; Second Test at Melbourne, 29th December to 3rd January; Third Test at Sydney, 11th to 16th January; Fourth Test at Adelaide, 25th to 30th January, and the last Test at Sydney, 15th to 20th February.

For all Test matches except the fourth the times and frequencies are: 0055 to 0545 on 17840 (16 metre band) and 21540 (13 metre band); 0430 to 0805 on 11710 (25 metre band); 0515 to 0805 on 17820 (16 metre band); 0615 to 0805 on 9570 (31 metre band).

The fourth Test will be broadcast as above excepting that both the starting and finishing times of the day's play will be 20 minutes later.

* * *

Our first reception of the new 100kw transmitter at Beirut, Lebanon, was had recently. The station was operating on 11720 and was causing considerable interference to CBC Montreal using the same frequency. The Lebanese broadcast was followed without much difficulty from around 1830 and we noted a news session at 1840. A foreign language was employed after 1845.

* * *

There have been tones of dismay from another source recently regarding the deterioration of the higher frequency bands in this period of the falling sunspots counts. Judging from an observation the writer made between 1800 and 1900 a day or so ago when no fewer than seven English-speaking stations, including the BBC on 21470 were heard, as well as an equal number of foreign broadcasters, all on 13 metres, condition are not too bad. Another listening session between 0900 and 1000, also on this band, revealed the BBC, the Far Eastern Service of Deutsche Welle, Germany, and Pakistan. It appears that these frequencies have recovered well from their winter doldrums and your correspondent won't be complaining — yet!

* * *

Just to confirm our own optimism in the future of S.W. Broadcasting we ran through the "future plans for expansion" items listed in the latest edition of the world Radio Handbook. No fewer than twenty organisations have definite plans for new equipment and services and the total increase in output from these new transmitters is nearly 8000 kilowatts!

* * *

SURVEY BY COUNTRY

CHINA: Further frequencies used by Radio Peking for their session beginning at 0830 are 9945 and 17830. Both fairly good. The others used at this time are 11650 and 15060. The station closes at 1025.

FORMOSA (TAIWAN): Current reception from "The Voice of Free China" obtained at two periods, from 0330 on 17890 and from 1010 to 1055 on 6095, 7130, 9685 and 11860. Excellent signals are received during the latter session.

WEST GERMANY: Deutsche Welle is heard at 0845 on 15270 (fair) and on 21705 at 0915 until 0930 (good). English is of course spoken during these broadcasts.

GREAT BRITAIN: Tune to 9705 at 1830 and you should hear a spot announcement stating that the BBC is relaying a Voice of America programme. The rest of the broadcast is in a foreign language. Other recent loggings are: from 1800 to 1830 when the signal fades, on 21470; at 0700 on 11930 (fairly good); from 0915 on, using 21470 (weak), 21550 (fair), at 1015 on 15310 (fair). Other transmissions from the BBC are still heard in the main as listed in "Around the Clock on SW", July issue.

HOLLAND. The frequencies now being used for Radio Nederland's "Happy Station" are 9630 and 11780. This programme is heard on Sundays only, running for 85 minutes, commencing at 0600.

INDIA: From 1000 to 1045 All India Radio transmits a session which is very well received here on 11715 and 17855.

JAPAN. Radio Japan's broadcasts are mainly heard on the 19 and 31 metre bands at present. Our reception is as follows: At 1900 on 9740 (interference — poor); at 2000 on 9525 (good); at 2330 on 15135 (good); at 2345 on 15390 (good); at 0030 on 15135 (weak); at 0100 on 15195; also at 0200; at 0300 on 15105 (poor); 15195 and 15325 (fairly good); at 0315 on 17895 (good); at 0400 on 15105 (fair) and 15195 (weak); also a poor signal on the latter frequency at 0500; from 0530 to 0615 on 15235 and 17725 (both good signals) to Hawaii; also at 0600 and at 0700 and 15195 (good); from 0730 to 0800 on 15235 (good), also at 0745, transmissions begins on 15135 (good). The latter channel is also heard at 0815 in European service but uses the Japanese language after 0830; at 0900 on 15325 (excellent); also excellent signals on 11875 and 15235 to Australia and N.Z. between 0930 and 1030; at 1000 good reception on 9505 and 9605.

NEW ZEALAND'S new schedule, effective from 24th November, has been anounced: 1700 — 1945 on 9540, 11780 to the Pacific Islands (or P.I.); 2000 — 0545 on 15280 (to P.I.); 2200 — 2230 on 11780 and 2245 to 0545 on 15110 to Australia; 0600 — 0845 on 9540, 11780 (to P.I.); Sundays only, 0815, — 0845 on 9540 to Antarctica; 0900 — 1145 on 9540, 11780 to Australia.

At our location, about 500 miles from Radio N.Z.'s transmitter's aerials we normally hear the 6080 chanel very well during the evenings. In July, however, even this signal disappears to return in strength during October. The 9540 outlet has not been heard here yet.

11780 arrives here best during midsummer around 0700 although it can occasionally be detected at poor strength at other times. 15110 has been poor excepting at odd occasions about noon. 15280 provides regular reception all the year round during daylight hours, but very rarely attains the strength of signal on 6080. Although it is realised that these transmissions are not designed for N.Z. listeners, we mention the above as an indication for many of our readers in this country who may wish to use our own external services.

PAKISTAN: An excellent signal was obtained on 21590 at 0930 from Radio Pakistan during a slow speed news session.

PORTUGAL'S "Voice of the West", has been heard on a new frequency, 11920 from 1845 (poor — interference). At this time it operates on 17895 also as previously reported. During the afternoon the session from 0345 to 0430 is still received on three frequencies, 6025 (good), 6185 (fairly good), 9740 (excellent).

U.S.A. Fresh loggings from "The Voice of America" are: from 1800 to 1830 on 21485 (good), 21570 (weak), 21590 (good); from 1800 to 2045 on 6135 (good); at 2030 on 9525 (fairly good); from 2045 to 2115 on 11900 (good); at 2130 on 15435 (good); from 0245 to 0315 on 11835 (fairly good); from 0400 to 0430 on 7220 (interference — poor); at 0615 on 5965 (interference — poor) and from 0630 to 0700 on 9755 (good) both carrying the "Breakfast Show"; at 0845 on 15370 (weak); from 0900 to 0930 on 15205 (fairly good); from 0945 to 1015 on 15150 (very poor).

U.S.S.R.: Radio Moscow has very nearly taken over the 41 metre band between 0500 and 0555 for their North American service. The frequencies used in this most concentrated radio barrage heard in years are 6965 (weak), 7065 (weak), 7150 (excellent), 7175 (fairly good), 7185 (fairly good), 7290 (good), 7325 (fairly good), and 7340 (excellent). A large proportion of what is left of the band at this time is covered by jamming stations.

Other recent additions are: African Service, 2100 — 2130 on 17740 (good); 2245 — 2255 on 11715 (fair) to U.K.; at 2330 on 12020 (weak) with Sports News; at 0100 on 9720 (weak) programme the same as that carried by 9690; at 0615 on 11980 (weak); at 0630 on 9730 (fair) Pacific Coast Service; 0645 — 0730 using 17740 (weak); at 0745 on 15360 (weak); at 0945 using 15140 (good signal).

* * *

In these notes we adopt an "order of time" approach to the setting out of multiple broadcasts from one country or organisation. This aids easy selection of frequency at the time you find most convenient to listen. We begin at 1800 GMT (6 a.m. N.Z. Time) through 0000GMT (Noon N.Z. Time) and then through the N.Z. afternoon and evening in which the GMT numerals can be directly translated into New Zealand Time, i.e., 0430 GMT = 4.30 p.m. NZ. Time.

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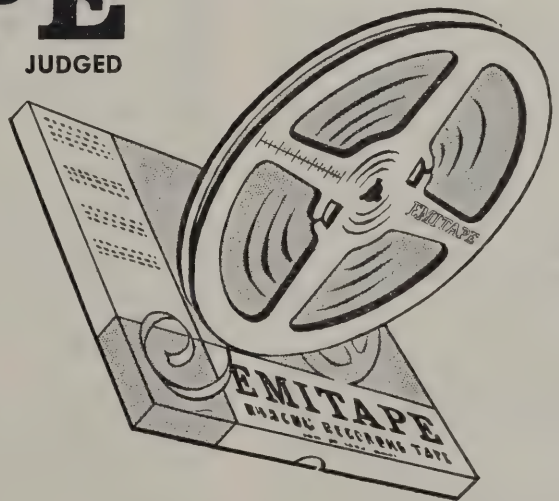

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SPACE RENDEZVOUS GUIDANCE AND DOCKING TECHNIQUES

Bringing two objects together in space, while they are travelling at some 17,000 miles per hour, obviously presents problems. Herewith, a general discussion of some rendezvous and docking techniques now under consideration.

A major technological step required for progress in space exploration is a practical, workable satellite rendezvous technique. Satellite rendezvous involves the controlled launch, ascent, and physical coupling of a chase vehicle with a target satellite already in orbit.

Satellite rendezvous will have many uses. In the near future, it could provide a means for obtaining maximum utilization from small boosters. For example, a manned lunar mission could be accomplished by rendezvousing two vehicles in an earth orbit — one a fuel tanker and the other a manned lunar capsule and a partially filled fuel tank. The manned lunar vehicle could be refuelled and launched from orbit towards the mooon.

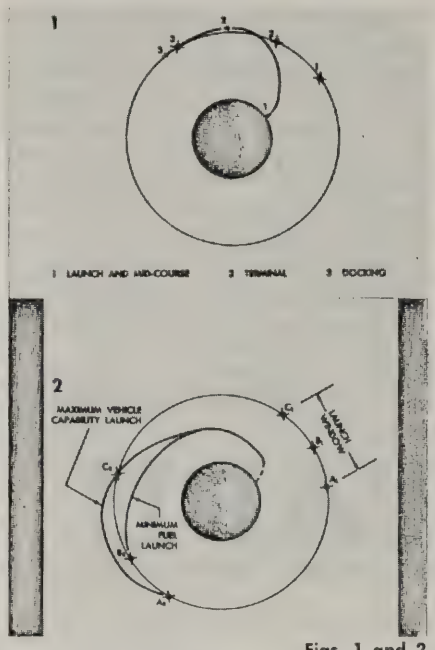
On a much longer range basis, a lunar rendezvous could save payload. A main earth-moon spaceship could be "parked" in a lunar orbit while a manned landing vehicle descended to the moon's surface. When the mission was completed, the smaller craft would rejoin the main vehicle.

Future deep space exploration will probably be made by large vehicles driven by electrical propulsion engines. While such propulsion is economical for outer space work, such engines have very low thrust. These space vehicles will have to be boosted into earth orbit by conventional liquid or solid rockets, and assembled in space.

Plans are presently under way to put a permanent earth satellite into orbit for use as a space test station. Here flight crews could be trained for future lunar and deep space missions. Zero gravity and high vacuum would provide the necessary environment for testing space suits, life support systems, propulsion systems, etc.

As the frequency of manned earth orbital launches increases, so will the chance for an equipment breakdown, preventing the astronaut's reentry. A rescue system is needed with satellite rendezvous capability and, of course, the ability to subsequently reenter the earth's atmosphere.

When the unmanned satellites become large enough, it will become economical to send a rendezvousing satellite up for repair purposes, rather than put a new satellite into earth orbit.



Figs. 1 and 2

Launch and Mid-course Guidance

The basic phases of a satellite rendezvous system are shown in Fig. 1. Complete knowledge of the target satellite orbit is needed to determine launch time and mid-course path of the chase vehicle. Generally, the chase vehicle will be launched when the orbital plane of the target is nearly coincident with the launch station. This opportunity exists twice a day if the latitude of the launch station does not exceed the inclination angle of the target orbit. For launch stations at greater latitudes, an in-plane launch is impossible, and rendezvous can be accomplished only by an orbital transfer to the target orbital plane. (An orbital transfer for a difference in inclination angle of only 10 degrees at a 300-mile altitude would require 3500 pounds of fuel for a vehicle initially weighing 10,000 pounds in earth orbit.)

In addition to an in-plane launch, the target satellite must be in a position that nearly coincides with the ascent trajectory of the chase vehicle. Of the innumerable ascent paths possible, two represent a minimum fuel and a maximum vehicle capability launch (Fig. 2) The spread between possible satellite positions at time of launch is known as the **launch window.** The greater the vehicle capability the larger the launch window. For reasonable vehicle capabilities, launch windows are small — only a few degrees of orbital arc.

The small launch window places a stringent requirement on launch time. For example, a satellite at a 300-mile altitude travels 4 degrees per minute; therefore, for a 4-degree launch window, the time of launching must be held to within one minute.

The size of the launch window can be increased by first launching the chase vehicle into an orbit of lower altitude than the target satellite. In this "parking" orbit, the chase vehicle has a higher angular rate than the target satellite and will gain on the target satellite, placing itself in a favourable position for orbital transfer to target satellite altitude.

The launch and mid-course guidance places the chase vehicle in the neighbourhood of the target satellite. At this time the chase vehicle is approaching its apogee and has separated from its booster stage. Since ground track sensing is inadequate to determine terminal guidance manoeuvers, the terminal flight path must be determined by a sensing and computing system in the chaser and target satellites.

Terminal Guidance

Engineers selected a variable time-to-go guidance technique to direct terminal manoeuvers. The chase vehicle is stabilized with respect to the horizon; its main

thrust engine is aligned along the orbital path so that it can accelerate the chase vehicle to orbital velocity. The terminal guidance sensor measures range, closing velocity, and bearing angle to the target. The ratio of range to closing velocity provides the time-to-go indication. These values are resolved along the three major axes of the chase vehicle. Nongimbaled, fixed-thrust engines are operated in an on-off mode to reduce closing velocity to zero in finite steps as time-to-go approaches zero along each axis.

The terminal guidance program shown in Fig. 3 illustrates the braking principle. Only the vehicle axis along the orbital path is shown. Rendezvous begins at a range of 70 miles and a closing velocity of 1000 feet per second. The program shown in Fig. 5 takes the chase vehicle to a range of 500 feet and closing velocity of less than 10 feet per second. (These latter points are too close to the origin to be shown in the figure.)

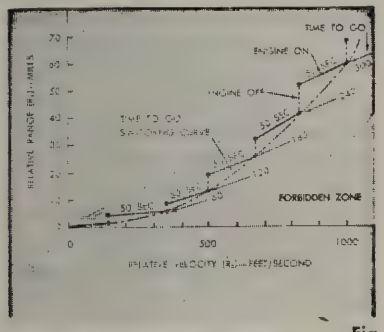


Fig. 3

Range, closing velocity, and bearing angles are determined by a radar sensor; radar was selected over optical methods because of well-developed ranging techniques and a negligible sun and background problem. To perform this task engineers developed a unique interrogator - transponder pulse type radar. A transponder is located on the target satellite to reply to the radar interrogating signal. This technique minimizes the transmitting power needed for initial detection. Non-gimbaled spiral antennas are used to measure bearing angle by interferometer techniques. These two techniques make possible a radar and transponder that weight only 32 pounds and draw 42 watts of primary power. The reduction in weight and complexity achieved by this design have produced an attendant increase in reliability.

Satellite Docking

The terminal guidance phase ends and the docking phase begins when the two vehicles are 500 feet apart. This distance permits transfer to the docking guidance mode at sufficient separation to avoid inadvertant collision from terminal guidance errors. In docking, the **relative position** between target and chaser becomes the basic reference so that proper orientation of each satellite can be provided for docking.

The transition to docking is initiated by the chaser and target satellites aligning themselves, by means of rotational movements, so that the two vehicles are perpendicular to the radar line of sight, with the long axis of the vehicles stabilized to the horizon. This is shown in Fig. 4 for side-to-side docking.

Once the vehicles are aligned they are maintained parallel; deviations off the line of sight are detected by the radar sensor and corrected by translational movements of the chase vehicle; the target maintains its attitude by purely rotational movements. Translational movements are used only by the chase so that cross coupling problems can be minimized.

Closing velocity is reduced and angle movement is performed by small attitude jets. Main thrust engines are no longer needed, obviating the problem of rocket flame damaging the target. When range is reduced to 5 to 10 feet, physical coupling is made between vehicles by a mechanical docking mechanism.

Close range coupling prior to contact separation after the docking impact. Otherwise, separation would require additional fuel expenditure to attempt a second rendezvous. Energy absorption at first contact and at rebound are necessary to dissipate the momentum of the closing vehicles. To absorb initial contact energy, absorption material can be placed on the impact surface of the chase vehicle, which will contact a hard

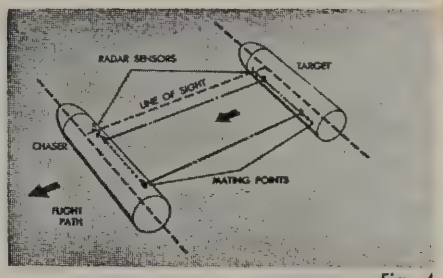


Fig. 4

surface on the target vehicle. The maximum closing velocity will determine the energy absorption requirements. The docking mechanism must have built-in capability to absorb rebound energy.

After rebound energy has been absorbed, the vehicles will be standing apart and must be brought together with a drive on the coupling mechanism. Transfers between vehicles will be accomplished by such mechanisms as vehicle-to-vehicle couplings to allow fuel transfer to the target vehicle, airlocks for transfers of personnel, or a coupling arrangement for the addition of booster sections.

After the mission is accomplished, the vehicles can be separated by releasing the coupling mechanism and applying a thrust from the attitude stabilization jets. Separation should be accomplished so that the target vehicle can accept multiple rendezvous.

Docking Techniques

Many techniques are possible for accomplishing the docking sequences. Some factors that should be considered in selecting a system are: weight, reliability, suitability for use with space vehicles, capability of accomplishing the mission, and compatibility with other rendezvous systems (guidance and control, etc.).

The basic docking method should be capable of coupling the two space vehicles side by side or end to end. Advantages and disadvantages exist for each technique. The basic components of docking hardware required for the chase vehicle are the coupling mechanism and its associated controls, energy absorbing material, drive mechanisms, and tow line. The target vehicle will require some form of coupling mechanism receptacles and a hard surface at the contact area.

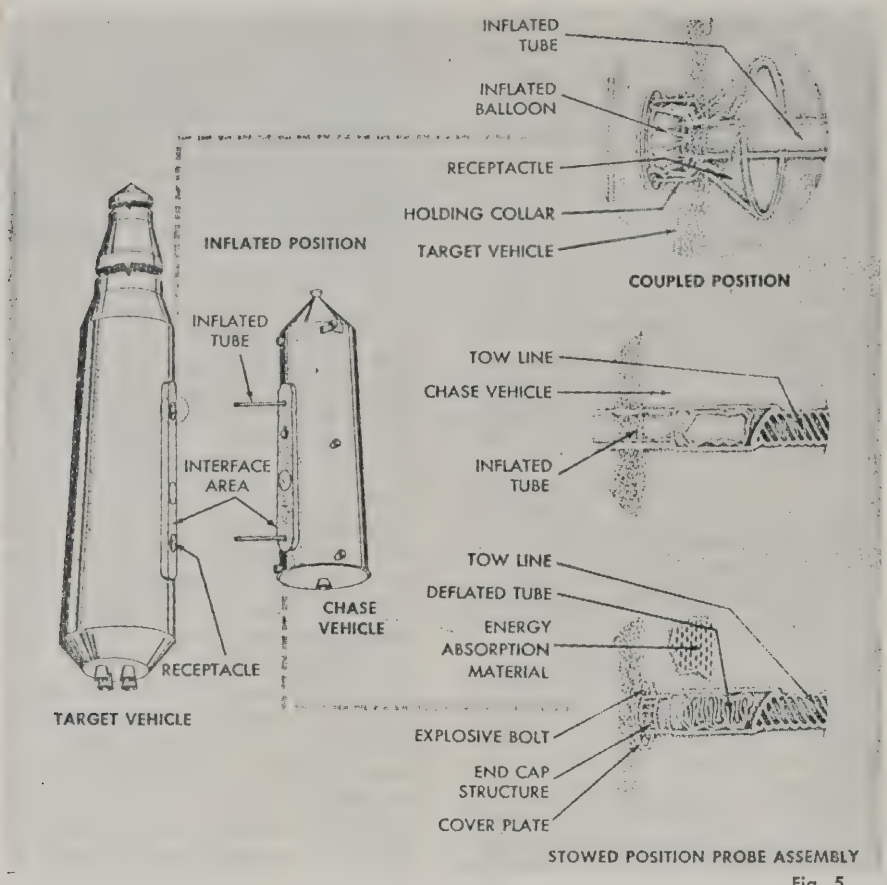


Fig. 5

Other components not required for the actual docking operation but needed for specific mission operations include air lock mechanisms, fuel transfer systems (pumps, tanks, connectors), mechanical and electrical connectors, etc. Additional structural parts, such as frames and stiffeners, may be required to transfer impact loading to the major structural members of the space vehicles.

One possible method of docking is illustrated in Fig. 5. Explosive bolts hold cover plates over cavities in the chase vehicle. Each cavity contains an inflatable hose and end-cap structure. During ground installation the tube assembly (including the end-cap structure) is pumped nearly free of air, Upon release of the cover plates, the tube is inflated by the small amount of residual air, so that an inflated tube and end-cap structure protrude from each of the cavities. This action takes place at a distance between vehicles greater than ten feet. The end cap of the tube enters the funnel-shaped receptacle in the target vehicle. This receptacle must be large enough to offset allowable guidance errors of the radar and control system. The end-cap structure consists of an inflatable balloon, contained within a series of hinged curved segments that make up a cylindrical tube. The assembly is held in place by an place by an explosive bolt arrangement. As the end-cap assembly passes into the throat of the receptacle, it intersects a magnetic field in the target vehicle. A sensor located in the lower section of the end-cap structure is activated by this magnetic field and triggers the explosive bolt, causing the balloon to inflate. This forces the hinged segments to a position shown in Fig. 5. The balloon assumes the shape of the cavity and provides the necessary pressure loading to establish the required tow line between the two vehicles before impact.

When the balloon, housed in the end-cap structure, is inflated, a sensor activates a drive reel in the chase vehicle and the tow line slack is taken up. When the vehicles impact, the energy absorption material on the chase vehicle removes most of the kinetic energy. The rebound energy is dissipated by a torque-limiting clutch which limits tension loads on the inflated tube and end-cap structure. When the vehicles come to rest, a speed-controlled motor reels the tube in, bringing the vehicles together.

Vehicle separation is accomplished by deflating the tube end-cap balloon, reeling it into the chase vehicle and activating the propulsion system.

Another possible docking technique employs a magnetic clamp or plate, which is guided into a receiving dock fabricated from magnetic material. The docking methods shown describe only two of several that were developed during the study.

Side-by-side docking has an advantage over end-to-end docking because it provides a larger interface area for energy absorption material, mechanical and electrical connectors, cargo or personnel transfer, refueling lines, etc. Side-by-side docking would provide a feasible means for building a cluster of modules for eventual rendezvous with a space-craft unit.

Since the majority of space vehicles are designed primarily to resist end loads, it is necessary to include additional bulkheads, stiffeners, intercostals, gussets, etc., in the spacecraft for side-to-side docking. With the proper design, loads can be transferred from the impact area to the spacecraft structure.

End-to-end docking requires a minimum of additional structure; the structure that has been designed to withstand the launch and boost acceleration loads should be nearly sufficient for reasonable levels of impact loading. End-to-end docking provides a means for adding modules in series to a space vehicle.

The mechanical design of a satellite docking mechanism is dependent, to a large extent, on the requirements of the space vehicles being docked. The docking phase can be mechanized in many ways; the choice will be determined by such considerations as suitability for use with space vehicles, capability of accomplishing the rendezvous mission, weight, and reliability.

WIRELESS PIONEER DIES

Mr. Simeon M. Aisenstein, whose death occurred on 3rd September at Chelmsford, was one of the great pioneers of wireless telegraphy and one of the world's foremost valve designers. He devoted enormous energy to the furtherance of research and exploration into electronics. Born in Kiev in 1884, he first turned his attention to wireless telegraphy as a boy of sixteen and studied at the Kiev University and the Charlottenburg Polytechnic. In 1905 Mr. Aisenstein's father helped him to establish his own experimental laboratory at Kiev. The Russian military authorities helped him to conduct experiments on a large scale and to erect experimental stations. In 1907 a wireless company was formed.

During the 1914-18 war he was responsible for all the high power stations in Russia and for the maintenance of communications with the Allies. He also conducted extensive experimental work in collaboration with the Russian Army and Navy; his pioneering work in establishing communicaation with submerged submarines was of great importance. In recognition of his services he was appointed a Councillor of State for the Russian Empire in 1915 and was made an Officer of the Legion of Honour by the French Government in the following year.

Mr. Aisenstein was imprisoned in the 1917 Revolution but managed to get away in 1921. In 1922 there was a development of radio in Poland and a Company, Radiopol, was formed under the management of Mr. Rudiger with Mr. Aisenstein as adviser. In 1935 Mr. Aisenstein left this company was formed, to make communication valves and tubes. In 1935 Mr. Aisenstein left this company to start a further development of another valve company in Czechoslovakia, but he left on the annexation of that country. Until 1941, he was engaged in radio equipment design. Then he took over the valve laboratories of Marconi. In 1947 the English Electric Valve Company was formed under the general managership of Mr. Aisenstein.

At various periods Mr. Aisenstein has been Professor a the Moscow Higher Technical School, member and vice-President of the Russian Society of Radio Engineers, and member of the Russian Society of Radio Engineers, and member of the Russian Technical Society and of the Physico-Chemical Society. He is the author of many patents and scientific papers. His lively interest and his deep humanity inspired others to follow his pioneering paths, and he will always be remembered as one of the great names of radio.

SERVICEMAN'S COLUMN

J. Whitley Stokes

The question of to what extent a serviceman should be more than just a "parts replacer" has concerned me for many years, and as yet I must admit to not having arrived at any hard and fast conclusion. In fact, due to the very nature of the problem, I doubt if it is possible to do so.

In case you're wondering what all this is about I should explain that I am referring to the question of how much should be done when a radio is in the shop for repairs (TV is not included here since most are still comparatively new).

Suppose, for example, someone brings in a small 5 valve set, which has been in use for several years, with the complaint that the volume control has become very noisy but otherwise the performance is O.K. and further suppose that, having replaced the defective control, and checked over set and found all voltage correct, you are prepared to hand back the set to the owner. Surely nobody can have any quarrel with this procedure, the fault has been repaired and the set checked over. What more could be required?

Every serviceman has had the experience of having a recently repaired set returned with the complaint:— "It's only two months ago since you fixed it and now its stopped again". The inference being that it wasn't fixed properly the first time. The question is, what can be done to reduce the number of such occurrence to a minimum? (short of completely re-building every set over 5 years old, that is!).

To return to our hypothetical case, suppose in your previous experience with this particular model, the 2 watt output transformer has been found to be the most common cause of trouble — so much so in fact that it is rare to come across one of these sets over five years which still has the original transformer. Under the circumstances would it not be wise to view the output transformer with suspicion, even though it might show no obvious signs of incipient failure?

What to do about it? Well I'm not suggesting that every O.P.T. should be replaced automatically as a precaution, but there is one thing that can be done which often helps to determine this condition. Some 27 years ago I learned the value of the screwdriver test on R.F. & I.F. primaries and it is this same acid test which can be used to determine the condition of suspected O.P.T. primaries. I think it is a fair assumption that if a winding won't stand this test, that it is on its way out and is likely to be the very thing that causes a set to "bounce". The only drawback to this test is that it will result in the breakdown of a winding which may be "hanging by a thread".

From the serviceman's point of view the question here is, which is better, to have to explain to the customer who only wanted a new volume control, that the O.P.T. broke down while you were testing the set, or to "let sleeping dogs lie" and take a chance on having the set bounce maybe only a few days later and the owner demanding to know why you didn't fix it properly the first time?

My own answer to this question is that it depends largely on how well you know the customer. If it is a new customer he may well be suspicious particularly if he has been "bitten" elsewhere, and you are apt to get blamed whatever course you take. Thank goodness I've got plenty of old customers!

PHILIPS

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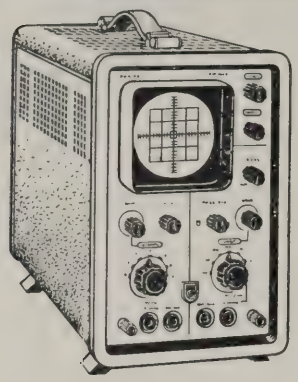

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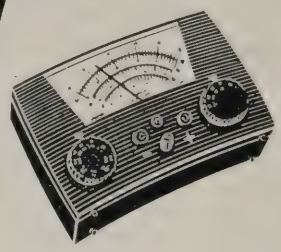

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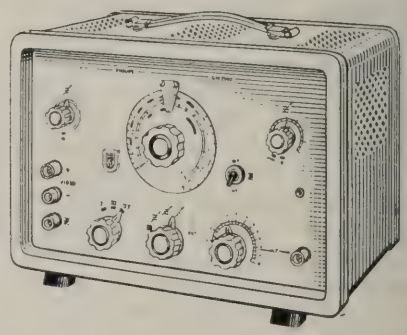

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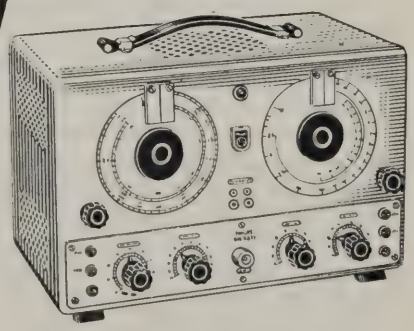

WOBBULATOR GM2877:

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NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

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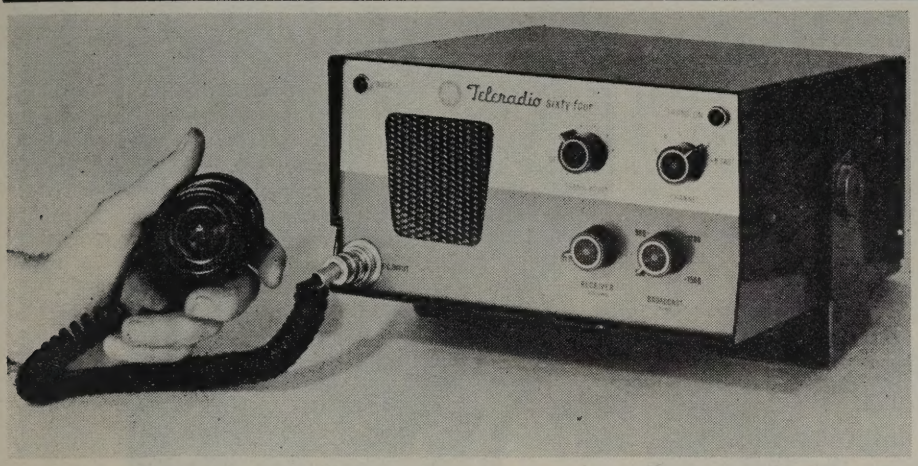


2-WAY MARINE RADIO-TELEPHONE

The Teleradio 64, designed and manufactured by Amalgamated Wireless (Australasia) N.Z. Limited, presents a new concept of simplicity of operation and reliability in marine radio. Of compact construction (5½in. x 10in. x 11in.), the Tereradio 64 is equipped with a universal mounting bracket which permits installation on control consoles, deckheads or bulkheads and yet allows easy removal for storage and maintenance. The cabinet is modern and functional. Five marine frequency channels are provided, with both the transmitter and the receiver crystal locked for straight-forward channel selection. The fully transistorised receiver also covers the full broadcast band from 550 kc/s to 1600 kc/s and provides powerful reception of distant and local stations. The Teleradio 64, featuring a transistorised high efficiency power supply and modulator, high transmitter output and available in 12 volt or 24 volt versions, offers new horizons in communications for small boat owners.

* * *

NEW STYLE PAY-TELEVISION DEMONSTRATED AT 1962 BRITISH RADIO SHOW

A system of television called "Choiceview," allows viewers to make use of an additional television programme fed via a stylishly designed box and landline or aerial to their set. It was developed by a British concern and is considered the most advanced of many similar systems, all undergoing field trials throughout the world. The company is expecting permission from the Government to operate this system on a limited trial scale in Britain. Forthcoming programmes on the alternative channel are announced in advance. The viewer switches to the programme he wishes to watch, then pays the charge after the programme. Before watching another programme on this extra channel, the previous programme viewed must be paid for.

BRITISH EQUIPMENT FOR U.S. TELEVISION

Two hundred electro-mechanical switching mechanisms for Colombia Broadcasting System's new studios in New York are to be supplied from the United Kingdom. These mechanisms, known as uniselector switches, can be governed by either a centralised computer, or manually from individual areas. Their purpose is to control circuits used in conjunction with studio and camera equipment. The new installation is expected to set future design trends for large networks of this type in the United States.

The motor uniselector was designed to provide a reliable and efficient switching medium for telephone exchange systems. It has been adopted by the British Post Office for switching long distance traffic and by many overseas administrations for both local and long distance switching. Low fault liability and flexibility has enabled the unit to be used for many unusual purposes outside the telecommunications field, including tele-cine camera switching, automation control equipment, calculator apparatus and broadcast programme switching. The switching system is capable of routing material from any of 200 sources to any of 130 destinations.

Associated Electrical Industries Ltd., London.

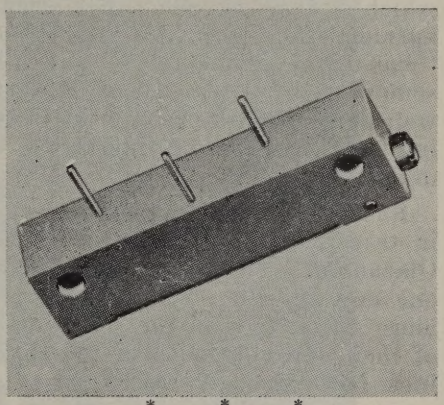
* * *

NEW TRANSISTOR RANGE

A new and comprehensive range of silicon transistors has been developed by a U.K. firm, Brush Crystal Co. Ltd. Designed primarily for fast switching in computer logic circuits and high frequency amplifiers, the units are sealed in an inert helium atmosphere by a process which produces very low leakage and very low saturation resistance. The 17 types in the new range are claimed to have unusually high stability and long life characteristics. Competively priced, they mark an important step forward in the semi-conductor field.

TYPE N PRESET POTENTIOMETER

A high quality sub-miniature potentiometer incorpates the Plessey moulded track feature with provision for alternative methods of mounting. For use in printed circuits, the connecting pins are arranged on the standard 0.1 in. (2.54 mm.) module. Alternatively, potentiometers may be mounted singly or one upon another by using the fixing holes in the body. A leadscrew is used to actuate the wiping contact and the unit is designed to occupy minimum space. Particular features are a fully-sealed construction, using a body formed in glass-filled polyester resin with sealed spindle, and a slipping clutch on the actuating screw which prevents damage through possible overwinding.



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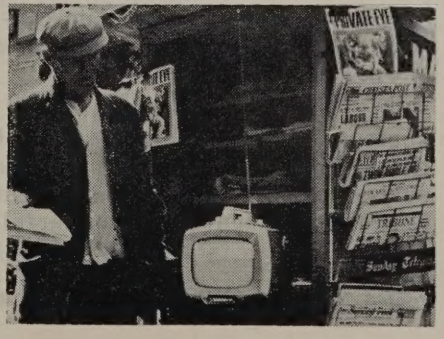
TRANSISTORISED PORTABLE TELEVISION SET

The illustration shows a newspaper seller with the latest British portable television set, the "Portarama." This superb, small set with the quality of a normal domestic receiver weighs just 17 pounds. A special 8½-inch radiant screen combats the bright light out of doors and power can come from a number of sources. The "Portarama" may be operated from normal AC mains electric supply; from an external 12 volt DC supply, such as provided by a car battery, or with its own rechargeable nickel-cadmium battery. These batteries supply power for four hours continual use and recharge in six hours. It is impossible to overcharge the battery.



Record Review

by Professor C. G. F. Simkin

KEY:

- • Not recommended because of poor performance or recording.
- ★ Recommended although the performance or recording has faults.
- ★★ Strongly recommended because both performance and recording are excellent.

★★**PROKOFIEV**, Symphony No. 1; and **SHOSTAKOVITCH**, Symphony No. 1; both played by the Philharmonia Orchestra, conducted by Efram Kurtz. World Record, TZ 174.

The two symphonies are pleasant, youthful works which get an excellent performance by the Philharmonia and are very well recorded. Prokofiev's "classical" symphony — so called because it is somewhat of a parody of Mozart — is especially well done. This symphony is always pleasant listening and Kurtz's interpretation makes it a pure delight, particularly in the slow movement.

Shostakovitch's first symphony is also grounded in tradition — here that of Rimsky-Korsakov and Glazounoff — but is rather more academic. Even so, one may question whether Kurtz does not take it more seriously than the composer intended, in spite of their consultation over the old metronome markings. Nevertheless it is, like the classical symphony, very well handled and the two make a most acceptable coupling.

* * *

★★**BEETHOVEN**, Quartets No. 12 in E flat major, Op. 127, and No. 16 in F major, Op. 135; played by the Hungarian String Quartet. The Record Society, RZ 6041.

This disc is a superb achievement — a magnificent recording of two magnificent performances. Beethoven's heroically gay E flat quartet is a gateway to the four great masterpieces which followed it, and the more disturbed F major quartet a reminiscent epilogue, not only to them, but to his whole musical life. The Hungarians illuminate these connexions and play with deep feeling as well as with genuine insight. Here, at least, their brilliant technique and faultless ensemble playing are fully controlled by meticulous tempi and scrupulous shading of tone.

Their mastery is evident from the broad chords opening the first movement of Opus 127, and in the unfolding of its gracious themes. The singing polyphony and delicately changing rhythms of the second movement are wonderfully exhibited. Nor could the complex scherzo or rambling melodious finale be better done.

Performance and recording maintain the same high quality in Opus 135. The whimsical first movement is sparklingly clear, and the vivace notable for a finely controlled decrescendo. Beethoven wrote nothing more lovely than the slow movement, and the Hungarians do it full justice. They also resolve perfectly the dramatic questioning of the last movement into confidently gay music.

No one who cares for Beethoven, or for chamber music, should be without this disc; it is not a luxury but a glorious necessity.

* * *

★**BRUCH**, Violin Concerto in G minor, Op. 26, and **MENDELSSOHN**, Violin Concerto in E minor, Op. 64; both played by Yehudi Menuhin and the Philharmonia Orchestra, conducted by Walter Susskind and Efram Kurtz. World Record, TZ 175.

Here again we have an appropriate coupling which can be confidently recommended. Neither concerto has the profound inspiration of Beethoven's or Brahm's, but their melodious qualities and fine musicianship have made them firm favourites. They are works which seduce the ear and inspire affection.

Menuhin and the Philharmonia give them competent performance, and the recording is good both for tone and balance. Nevertheless Menuhin's tone often sounds rather thin and sometimes uneasy, more especially in the andante of the Mendelssohn concerto, and his interpretation is a bit too flat to capture the full beauty of either concerto. He does better in the Bruch, and brings off the finale convincingly with appropriate aid from the orchestra which also seemed below its usual brillance in the Mendelssohn concerto.

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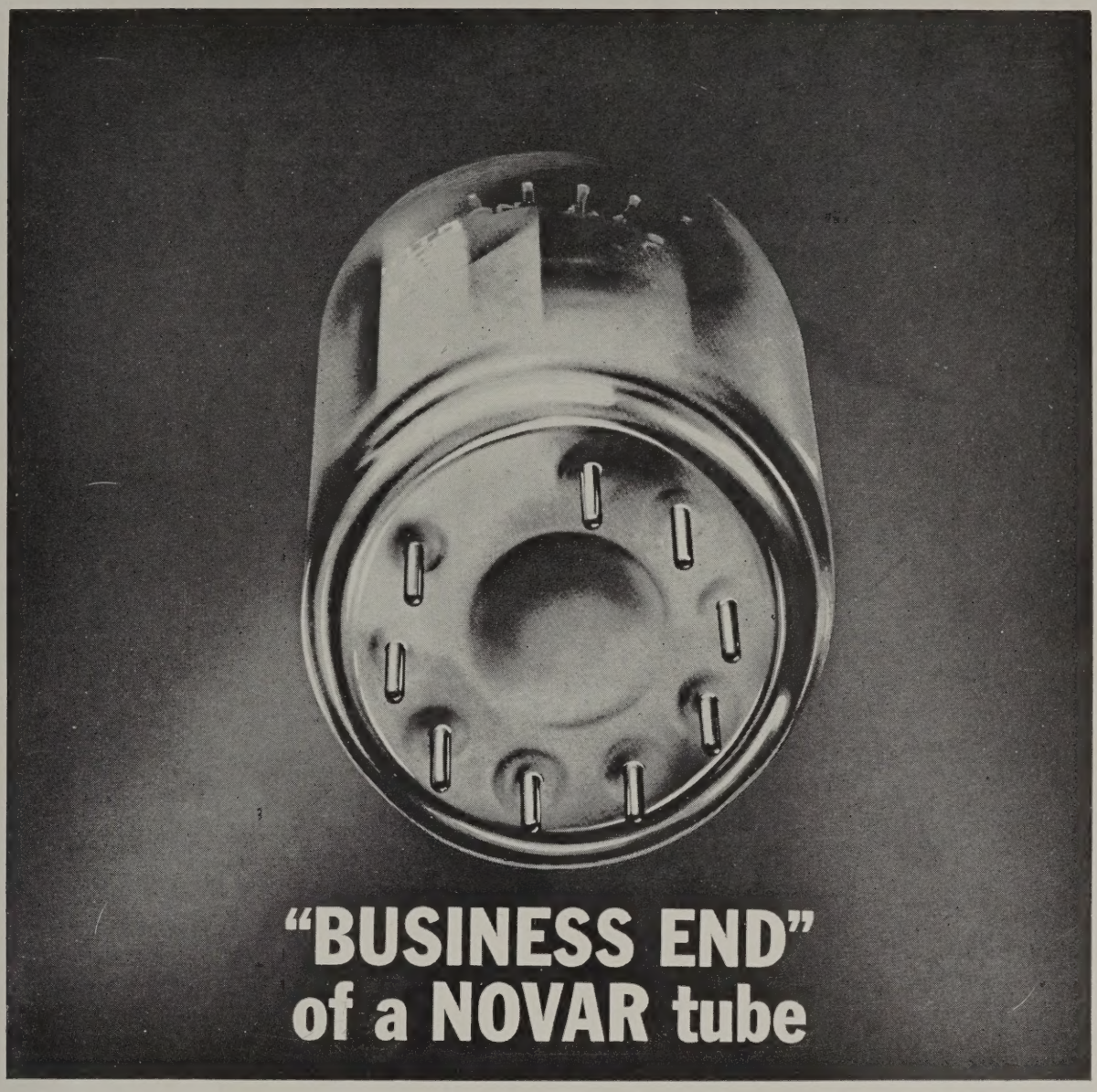

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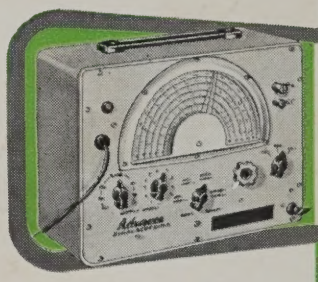

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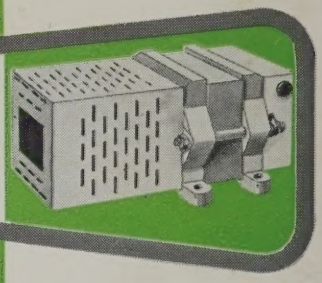

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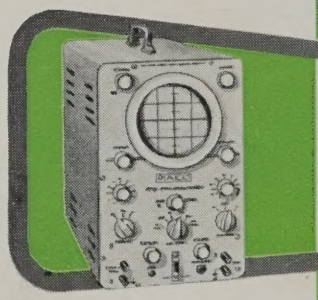

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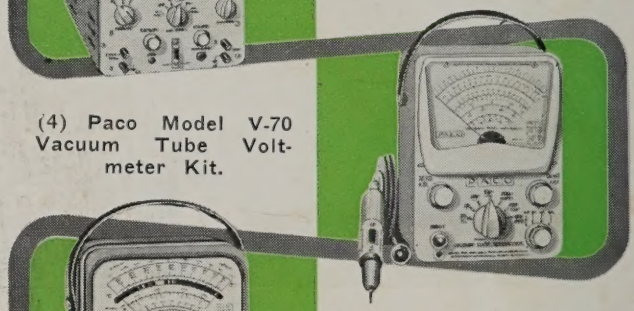

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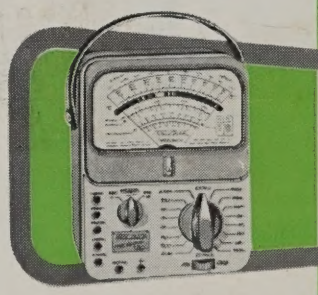

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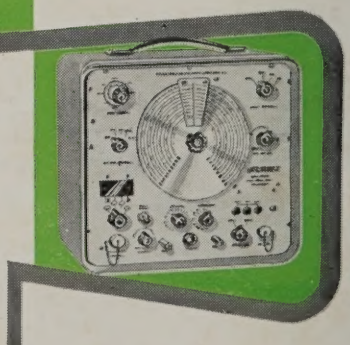

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